

Evidence review of the food contents on carbohydrate and fats shelves of the food pyramid



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Summary

Background

This Health Research Board (HRB) evidence review was requested by the Health Promotion Policy Unit (HPPU) of the Department of Health to determine whether the current food pyramid and associated diet-related tips need to be updated, in order to ensure a balanced diet and healthy lifestyle among the Irish population.

The food pyramid is reviewed as new evidence emerges; findings from the most recent formal review were published in 2010. Currently, there is discussion in the nutrition literature about the balance between carbohydrates and fats in a healthy diet. This evidence review will be used to ensure that the food pyramid is consistent with appropriate international recommendations; the review will be used in the formulation of the new National Nutrition Policy.

- Healthy eating guidelines will be informed by this evidence review. The target population is healthy Irish adults and children aged five years and over (but excluding people who are obese or who require special diets).
- The outcome anticipated by the HPPU is up-to-date evidence that demonstrates the appropriate composition of the food pyramid, with a particular focus on simple and complex carbohydrates and fats and oils, in addition to evidence that clarifies the issue of the fats and carbohydrate seesaw effect.

Review questions and their interpretation

The review questions are:

1. What are the recommended number of servings, serving or portion sizes, and calorie content for simple and complex carbohydrates, individually and combined based on the most recent scientific evidence?
 - a. With respect to this question, we have interpreted simple and complex carbohydrates as refined and unrefined carbohydrates, as this is in line with current practice.
 - b. We have reported the amount of energy that is required from carbohydrates as calorie contributions recommended in the international literature.
 - c. We have measured carbohydrate intake, taking into account grains, fruit, vegetables and refined sugar consumption recommendations in a number of omnivore diets or food pyramids.
2. What are the recommended number of servings, serving or portion sizes, and calorie content for fats and oils (including monounsaturated and polyunsaturated as a proportion of saturated fats), based on the most recent scientific evidence?
 - a. We have reported the amount of energy that is required from fats as calorie contributions recommended in the international literature.

- b. We have measured fat intake taking into account the meat, fish, dairy, added oils and fat and non-essential high fat products recommendations in a number of omnivore diets or food pyramids.
3. What is the ratio of, and inter-replacement possibilities for, carbohydrates and fats, based on the most recent scientific evidence? Is there an ideal ratio? Is there a seesaw effect? Is there a replacement argument that allows substitution between carbohydrates and fats?
 - a. We present a summary review of the fats and carbohydrate seesaw effect, and the most recent evidence on the link between carbohydrates and fats and cardiovascular disease.

Methods

This review set out to identify the most recent evidence on the recommended number of servings, serving or portion sizes, and calorie content for 'refined and unrefined carbohydrates'; 'fats and oils', individually and combined. Throughout the review, we use the term 'fats' to refer to 'fats and oils' as a nutrient group. As the macronutrients, carbohydrates and fats are contained in foods featured on a number of the pyramid's shelves; we have covered all relevant shelves in the pyramid, as it is not possible to comment on intake of these macronutrients without taking account of carbohydrate and fat intakes from shelves such as dairy, meat or discretionary foods.

A multi-pronged search strategy was used to:

- Develop an understanding of the subject matter through iterative searching of a range of literature databases and of international and national-level organisations.
- Identify key search words, in particular 'food pyramid', and the term 'food-based dietary guidelines' (FBDGs). The words and terms were linked with a range of different countries names, and each phrase was individually pursued through the Google search engine.
- Undertake a review of a range of nutritional peer-reviewed journals covering the period 2010 to February 2014, in order to understand the historical development of, the approach to, and the nature of the evolution of FBDGs.
- Identify the working framework currently adopted to address the review questions. This framework includes the identification of: national-level survey data on population food consumption patterns, anthropometry and morbidity profile; national food composition databases; systematic literature reviews on the diet-health relationship; the development of recommended dietary intake and the development of FBDGs. We reported the findings of this evidence review using this framework.
- Identify recent and appropriate data sources, in order to gather relevant information on serving or portion sizes, and calorie content of the named foods.
- Prepare country-based examples to answer questions 1 and 2, and compare these examples with Ireland.
- Summarise the literature on the fats and carbohydrate interrelationship for Question 3 by concentrating where possible on systematic reviews and cohort studies.

It became clear to the HRB authors from the various search results generated that substantive expert experience had been consolidated into the development of agreed international FBDGs. There are

regional and national variations in the execution of these guidelines. Over time new scientific knowledge has been incorporated into the development of FBDGs. Nevertheless, a marked commonality in development of the guidelines is apparent across all countries. The HRB authors' preliminary findings indicated that there was a need to review primary or secondary numeric nutritional data sources, which required examination of:

- food composition databases, in order to ascertain the sources of carbohydrates and fats
- the contribution of various foods, in order to recommended daily or weekly dietary intake of carbohydrates and fats, and examination of how these contributions are calculated
- the translation of information on nutrients into FBDGs.

It is important to note that the secondary data sources (i.e., the use of aggregated or composite data) to identify the daily or weekly serving and portion sizes reflect variation in national-level inclusion and exclusion grouping or classification criteria. Such variations reflect not only factors such as nutritional content in determining how foods are grouped, but also socio-political and cultural country-specific norms. The consideration of findings should take account of such variations.

We used a country-specific approach to identify the national-level recommendations and guidelines on servings, serving or portion sizes and calorie content. In line with the dietary data reported in the Department of Health's publication *Your guide to healthy eating using the food pyramid*, we concentrated on predominantly 'western' omnivore diets. The countries used as case studies were: Australia, Canada, Sweden, the United States of America and the United Kingdom. We excluded reporting on vegetarian, Mediterranean, vegan, pasta-based or rice-based diets, as it became apparent that individual modelling of the data was required for each diet type.

Nutrients, food and its composition, requirements and guidelines

Proximates, the collective term used for the biological materials consumed by humans, comprise of ash (including minerals and vitamins), moisture (water), carbohydrates, fats and proteins. The macronutrients carbohydrates, fats and proteins are present in varying quantities in vegetables, fruit, grains, meat, fish, nuts and seeds and dairy produce. The number of food groups identified from food produce varies from country to country; it usually consists of either four or five groups, but it can be higher. The U.S. Department of Agriculture 2013 National Nutrient Database for standard reference on the composition of raw, processed and prepared foods lists 25 food groups comprising 8,463 individual foods. The criteria employed in grouping food varies: the predominant nutrition content, the agricultural base from which food originated, or consumers' uses are three commonly employed methods of bundling foods. How foods are grouped determines the subset variation composition of the identified groups.

Carbohydrates are chemical compounds that contain carbon (C), hydrogen (H), and oxygen (O) atoms. They are composed of sugars bonded together, also known as saccharides, and are technically hydrates of carbon. The term 'carbohydrate' is defined as polyhydroxy aldehydes, ketones, alcohols, acids, their simple derivatives and their polymers, having linkages of the acetal type. The primary classification of carbohydrate is based on chemistry, i.e., the character of individual monomers (e.g., monosaccharides), degree of polymerisation (DP) and type of linkage (α or β^2), as recommended by the Food and Agriculture Organization/World Health Organization Expert Consultation in 1997. This divides carbohydrates into three main groups: sugars (monosaccharides and disaccharides, DP 1–2),

oligosaccharides (DP 3–9) and polysaccharides (DP ≥ 10). There are four types of carbohydrates, each of which are classified by the number of sugar molecules they contain. These are: monosaccharides or simple saccharides (glucose and fruit); disaccharides (milk); long chain saccharides (vegetables); polysaccharides (starch, glycogen). Foods containing refined carbohydrates are often highly processed; such foods include table sugar, honey, sweets, soft drinks, biscuits, breads, crackers, jams, jellies, pastas and breakfast cereals. Unrefined foods usually contain natural carbohydrates; such foods include beans, tubers, whole grains and unrefined fruit. Whole grains and wholegrain foods comprise three edible layers of the grain, seed or kernel. Each layer provides a unique combination of nutrients. Dietary fibre is the indigestible portion of carbohydrate derived from plants. Fibre is a type of carbohydrate that the body cannot digest and therefore excretes.

Although the words '**oils**', '**fats**', and '**lipids**' are all used to describe fats, in reality, fat is a subset of the **lipid** group; the term 'lipids' is used to refer to both liquid and solid fats. The term 'oils' is usually used to refer to fats that are liquid at room temperature; these lipids contain mainly unsaturated fats. Some examples of foods that contain high amounts of polyunsaturated fat include soya bean oil, corn oil, safflower oil, walnuts, sunflower seeds, sesame seeds, pumpkin seeds, flaxseed, fatty fish, soya milk and tofu. Examples of foods containing a high proportion of monounsaturated fats include olive oil, canola oil, sunflower oil, peanut oil, sesame oil, avocados, olives, nuts and peanut butter. The term 'fats' usually refers to fats that are solid at room temperature; these contain mainly saturated fats. Some examples of foods that contain saturated fat include: high-fat cuts of meat, dairy products, ice cream, palm oil, coconut oil, and lard. Trans fats are solid fats, and are found mainly in commercially baked or prepared foods such as pastries, cookies, cakes, pizza dough, packaged snack foods, stick margarine, vegetable shortening, deep-fried foods and candy bars. Vitamins A, D, E, and K are fat soluble, meaning that they can only be digested, absorbed, and transported in conjunction with fats.

Nutrients are distributed in varying quantities in most **foods**, raising the difficulty of considering one aspect of the human diet without considering its influence on the complete diet, and in turn the difficulty of considering one shelf on the food pyramid without considering other shelves – in order to create a complete and balanced diet. For example, quantities of carbohydrates are found on the shelves containing vegetables, fruit, meats, and also on the shelf containing grains and starchy vegetables. Quantities of fat are found on the shelves containing dairy, fish, meat, grains and fruit, and also on the shelf containing fats and oils. All commercially prepared oils (predominately unsaturated fats) also contain between 8 and 28% saturated fats. In addition, the nutrient content (raw unprocessed food) is different to that of cooked food and much different to that of processed food products, whether cooked or uncooked. The cooking process affects the carbohydrate content of grains, whereas the manufacturing process affects the lipid content of grains. Even within produce, the nutrient values of foodstuffs differ. For example, the values for produce such as apples or potatoes 'with skin' differ from the same products 'without skin'; similarly, the value for 'trimmed' meat differs from 'untrimmed' meat.

In general, foods are grouped into one of four or five food groups; this variation in the number of food groups reflects differences in country-specific 'food clustering' practices. The most common food groups consist of vegetables and/or fruit, grains, meats and alternatives, including seafood, and dairy products and alternatives. Most foods are regarded as representative of a specific macronutrient (protein, fat or carbohydrate). As a result, foods may be erroneously referred to by the specific macronutrient that constitutes their major portion of the nutritional value; alternatively, they may be referred to by the cluster into which they are grouped. Each individual food and its food group consist of a mix of the three macronutrients; proteins, fats and carbohydrates. For example, sweetcorn

contains protein (3%), fats (1%) and carbohydrates (19%). By contrast, the vegetables group, which is made up of a combination of sweetcorn, mushrooms and peppers, has a macronutrient total distribution of protein (7%), fats (2%) and carbohydrates (32%). In spite of this heterogeneous macronutrient mix, both the individual vegetables and the vegetables group are essentially regarded as a carbohydrate-rich food and may be referred to as a 'carbohydrate'. This fact demonstrates the problem with using macronutrient terms when providing guidance on recommended intake using a food pyramid as the demonstration tool.

Food composition tables or databases are resources providing detailed information on the nutritional composition of foods, and contain information on a range of components, including macronutrients, various micronutrients (minerals, vitamins) and energy. These databases are the fundamental information resource for nutrition science and are used to assess nutrient intake at the individual, regional, national or international level. The European Food Information Resource (EuroFIR 2008) has established a common standard for the identification and description of foods in European food composition databases, and allows the application of state-of-the-art concepts that facilitate systematic data collection, database linkage and exchange of food composition data. EuroFIR collaborates with 30 partner/national food composition database compilers across Europe, including one based at University College Cork. The Department of Agriculture in the USA has one of the largest food composition databases.

In the literature, the **key factors which determine nutrient requirements** include age, sex and physical activity level. In general, population-based dietary advice is targeted at healthy individuals or those with only mild metabolic disturbances; it does not cater for the specific needs of pregnant/breastfeeding women and persons with morbid conditions. A range of micronutrients and macronutrients are essential for healthy growth and development; micronutrients include various vitamins, minerals, organic acids, while macronutrients include carbohydrates, fats and proteins. When determining population-based diets, the intake of micronutrients and macronutrients for the target population needs to be calculated taking into account factors such as age, sex and physical activity; failure to achieve the right balance of micronutrients and macronutrients results in excessive or deficient intakes.

Energy is measured in kilocalories (often written as calories) or kilojoules. One kilocalorie (kcal) is equivalent to 4.18 kilojoules (kJ). The average amount of energy released from one gram of food ranges from approximately 16.7 kJ/g carbohydrate or protein to 29.3 kJ/g for alcohol and 37.7 kJ/g for fats. The basal metabolic rate (BMR) is the lowest amount of energy required to keep the body alive. BMR represents about 45–70% of daily energy expenditure, depending on age, sex, body size and composition. Physical activity is the most variable determinant of energy need and, after BMR, it is the second largest user of energy.

Micronutrient requirement levels are determined from the **literature** and are reported as summary measures and lower or upper micronutrient intake limits. **Macronutrient levels** can be derived through **statistical modelling**, working with predefined parameters. In some instances it is not possible to ensure an adequate intake of a specific vitamin or mineral while staying within the recommended macronutrient range, and therefore supplementation is required. Designing diets that conform to a given set of nutrient requirements (both minimum and maximum) while taking account of dietary energy is complex. A number of statistical modelling tools are used by individual countries. The modelling methods employed in the development of the most recently published dietary guidelines in Australia (2013) is consistent with the modelling process undertaken in the development of the

Canadian (2007) guidelines and the U.S. Department of Agriculture (USDA) (2010) guidelines. The model takes account of the following: amount of each nutrient in each food; portion size; number of portions; range of foods that provide the nutrient, and local preferences. The specific type of statistical modelling currently employed is linear programming. The Australian model also takes account of the sustainability of the food production process and, while it is not part of the remit of this review, the sustainability of food production processes represents a very interesting and important aspect of food consumption, cultural practices and environmental sustainability.

Food-based dietary guidelines (FBDGs) are simple but relevant messages on healthy eating aimed at the general public. They give an indication of what a person should be eating in terms of foods (as opposed to nutrients), and they provide a basic framework to use when planning meals or daily menus. The World Health Organization (WHO) recommends that FBDGs express nutrients as foods, and that they express nutritional facts in everyday language. In the European Food Safety Authority Scientific Opinion document **seven steps** for developing FBDGs were identified. As follows:

1. identification of diet-health relationships through the scientific literature
2. identification of country-specific diet-related health problems by analysis of country-specific data
3. identification of nutrients of public health importance, taking account of scientific findings from previous steps
4. identification of foods relevant for FBDGs through statistical modelling of the food groups
5. identification of food consumption patterns through statistical analysis
6. testing and optimising FBDGs, and
7. graphical representation and testing of FBDGs, usually accompanied with detailed text-based guidelines and, increasingly, more commonly accompanied with interactive websites.

The joint FAO/WHO consultation report presents some **factors to be taken into consideration when introducing FBDGs** to the general population. As follows:

1. They should be short and clear, easily remembered, and understood by the general public.
2. They should communicate clear and comprehensive messages, using text and visual aids.
3. They must be culturally acceptable with respect to dietary habits, beliefs and lifestyle.
4. They must encourage achievable targets, as radical changes to current habits will be less successful. They must provide educational materials for professionals so as to enable them to deliver a clear and consistent message.
5. They need to be communicated using a wide selection of media.
6. They should target messages to relevant groups.
7. They should be practical to implement, i.e., the foods recommended must be available, affordable and acceptable to the population.
8. They should be tested by nutritionists and consumer representatives (such as nurses, teachers and community leaders) and, following revision, tested by members of the public.

In Ireland, the current recommendations from the Department of Health, based on realistic targets, is that the **calorie or energy content** of a balanced diet is obtained from protein (15%), fats (30–35%) and carbohydrates (45–65%). The recommended daily calorie intake for active adults in Ireland is between 1,800 calories (women) and 2,200 calories (men); the calorie content is less for sedentary adults. This is within the upper and lower limits recommended by regional and international bodies; these limits are 10–35% for protein, 15–36% for fats and 45–75% for carbohydrates (please note

these ranges represent a combination of the upper and lower limits of the relevant organisations and not just one organisation).

Questions 1 and 2

The first two questions in this review (i.e., information on the recommended number of servings, serving or portion sizes, and calorie content for carbohydrate-rich and fat-rich foods and other foods that influence carbohydrate and fat intake) are addressed using empirical evidence on omnivore diets from Australia, Canada, Sweden, the USA and the United Kingdom (England). Each country is dealt with separately; findings for countries with the most relevant data are then compared to the guidelines for Ireland.

Country recommendations: Australia, Canada and the USA

The **Australian** guidelines published in 2013 were developed over a 16-year period follow the seven-step FBDGs set out by European Food Safety Authority.

The dietary recommendations reviewed 22 food exposures and 120 disease or health-related outcomes. The micronutrients addressed were thiamine, vitamins A and C, folic acid, calcium, iodine, iron, magnesium, zinc and linoleic acid, as deficiencies of these nutrients may have morbid consequences for the population. Diets were modelled to provide as close to 100% of the recommended daily intake (RDIs) for the aforementioned 10 key micronutrients as was feasible. The food groups identified in the published 1994 dietary recommendations were restructured using the latest scientific understanding of the beneficial or detrimental impact on health of specific foods and their nutritional content. The resultant food groups used in the statistical modelling process for the 2013 FBDGs were grains (stratified by whole or refined products); vegetables (stratified by starch content) and fruit; meats and alternatives (including legumes and pulse products); milk and alternatives (stratified by fat content). The food consumption patterns and national activity data used to determine the acceptability and feasibility of diets to be modelled were derived from a range of relevant national surveys. Linear statistical programming was applied to identify, develop and test optimum dietary patterns. More than 100 seven-day dietary models were developed for a number of age ranges (4–8 years, 9–11 years, 12–13 years, 14–18 years, 19–50 years, 51–70 years and 70 years and over); for males and females; for adults by physical activity levels (very sedentary lifestyle and the range of physical activity levels between 1.4 and 1.7); and for groups of different heights (adult males of 160 cm and females of 150 cm).

Two basic diet types were developed: 'foundation diets' and 'total diets'. The foundation diets were designed to provide the optimum recommended dietary intake for the youngest in each of the age groups under 18 years, and for sedentary individuals in the adult groups. The total diets were designed to provide the optimum recommended dietary intake for the energy needs of each age-sex group above the needs provided for by foundation diets. Total diets were constructed by adding to the foundation diets further servings of the various food groups used in composite modelling. A sample series of six diets was designed for each age-sex-activity level group. Total diets were reality tested by stimulating 100 seven-day diets for each age-sex-activity level group.

The additional foods included polyunsaturated margarine (as a representative food of the unsaturated fats and oils foods) and foods from what was named as the 'other foods or discretionary choices' category, such as foods high in fats or sugars. A set of guiding principles are proposed to assist in

compiling bespoke diets. These include choosing freely from the vegetables, fruit, cereals, and nuts and seeds categories and considering additional servings of milk/yogurt/cheese, red meat and poultry/fish/seafood/eggs/legumes in preference to choosing those in the 'discretionary choice' category. Limits on overall calorie intake levels, as well as limits for the macronutrients (protein, fats and carbohydrates) nested within the overall dietary requirements, were stipulated.

Serving sizes resulting from the translation of recommended dietary intake into dietary guidelines are reported by age-sex-activity levels. Examples of standard servings for the various food groups include:

- For grains, one slice (40 g) of bread; half a medium-sized (40 g) roll or flat bread or half a cup (75–120 g) cooked rice, pasta, noodles.
- For starchy vegetables, half a cup of sweetcorn or half a medium-sized potato.
- For other vegetable types, 75 g or half a cup of cooked green or orange vegetables (for example, broccoli, carrots).
- For unsaturated fats/oils/spreads, 10 g polyunsaturated spread; 10 g monounsaturated spread or 7 g monounsaturated or polyunsaturated oil (for example, olive oil, sunflower oil).
- For meats, 65 g cooked (90–100 g raw) lean meats (for example, beef, lamb).
- For milk and yogurt, one cup (250 ml) fresh, long-life, or reconstituted milk; half a cup (120 ml) evaporated milk; two slices (40 g) hard cheese; three-quarters cup (200 g) yogurt, or one cup (250 ml) soya, rice or other cereal-based drink with at least 100 mg of added calcium per 100 ml.
- For nuts 30 g (for example, seeds, peanut, almond butter).

The range of daily serving recommendations for both males and females, at all activity levels for those aged 4–70 years and over addressed in the guidelines was:

- 3–7 servings per day of grain-based foods.
- 4.5–6 servings per day of vegetables (including starchy vegetables)
- 1–4 servings per day of polyunsaturated margarine
- 1.5–3 servings per day of lean meat, poultry, fish, eggs, nuts and seeds, and/or legumes/beans
- 1.5–3.5 servings per day of milk, yogurt, cheese and/or alternatives
- 0.3–1 serving per day of nuts or seeds.

Recommendations were also made on a final food option, the 'discretionary choices' group – so called because they are not an essential or necessary part of healthy dietary patterns, and comprise food choices that are high in kilojoules/kilocalories (kJ/kcal), saturated fat, added sugars and/or salt or alcohol. While recognised as contributing to the overall enjoyment of eating, it was agreed that most Australians need to eat these foods less often and in smaller amounts, and to greatly increase physical activity, in order to 'burn off' the added kilojoules from discretionary choices, and thus help prevent gaining excessive weight. People deemed to be short, small or above their healthiest weight, as well as those who were not very physically active, were identified as having little or no room in their usual dietary pattern for any discretionary choices.

As a complementary educational tool, contemporary population diet-related concerns were specifically addressed through a limited number of key targeted messages. These addressed:

- excessive dietary intake of fat, sugar and alcohol
- deficiencies in vegetables and fruit intake or specific vitamins or minerals.

Excessive dietary intake messages identified 'culprit' foods and provided examples of alternative replacement foods or cooking preparation methods as a public health information aid. For example, the guidelines recommended 'eat less saturated fat by eating fish and legumes/beans rather than meat',

and 'grill instead of deep-frying food'. Messages on dietary deficiencies advocated increased intake of vegetables and fruit and, where necessary, supplementary vitamin intake.

Diets other than omnivore diets were modelled for Australians. However, in order to match the Irish Department of Health's dietary guidelines, only advice on omnivore diets has been reported on in this review.

The **Canadian** guidelines published in 2007 recommended the following serving sizes for those with a sedentary lifestyle, by age and sex. Examples of standard servings for the various food groups include:

- For grains, one slice of bread (35 g); half a bagel (45 g); 125 ml (half a cup) of cooked rice or pasta or 30 g cold (raw) cereal.
- For vegetables, one medium-sized fresh vegetable or fruit equivalent to 125 ml (or half a cup); 250 ml (or one cup) of salad or raw, green leafy vegetables; 125 ml (or half a cup) cooked green leafy vegetables; 60 ml (quarter of a cup) dried fruit.
- For fats, a small amount i.e., 30–45 ml (5 to 9 teaspoons) unsaturated fat each day, which may include oils used for cooking, salad dressings and margarine; for nuts or seeds, 60 ml (quarter of a cup).
- For milk and alternatives, one cup of milk or fortified soya beverage (250 ml), 175 g (three-quarters of a cup) yogurt and 50 g (1.5 oz.) cheese.

The range of daily serving recommendations for both sexes with a sedentary lifestyle, for those aged 4–51 years and over addressed in the guidelines was:

- 4 to 8 servings per day of grain-based foods
- 5 to 10 servings per day of vegetables and fruit
- A small amount i.e., 30–45 ml (5 to 9 teaspoons) unsaturated fat each day; this included oils used for cooking, salad dressings, margarine and mayonnaise
- 1 to 3 servings per day of nuts and nut products, lean meat and poultry
- 2 to 4 servings per day of milk, yogurt, cheese and/or alternatives.

The recommendation with respect to foods outside the four identified food groups was to limit the intake of fats, confectioneries and sugars, non-alcoholic beverages and salty snack foods; foods high in calories, fat, sugar or salt (sodium).

The key targeted messages included, but were not limited to, recommendations to 'make at least half the grain products consumed each day wholegrain'; 'attain a diverse grain dietary intake'; 'use low-fat milk products'; 'trim meat'; 'eat at least one dark green vegetable and one orange vegetable each day'; 'consume vegetables and fruit more often than vegetable/fruit juice'; 'choose vegetables and fruit prepared with little or no added fat, sugar or salt'. The messages also included advice to 'eat vegetables and fruit at all meals and snacks'; 'steam or microwave vegetables with sliced ginger or garlic'; 'toss chopped vegetables with a small amount of olive oil and bake in the oven'; 'cook main dishes with lots of vegetables'; 'use a little oil in stir-fries or ratatouille'; 'use low-fat yogurt or low-fat sour cream'; 'use fresh or dried herbs, spices, flavoured vinegars or lemon juice instead of salt to enhance the flavour of vegetables'. In specific instances, supplementary nutrient intake was advised. For example, the food-based dietary recommendation for adult males over 50 years did not reach the threshold for Vitamin D requirements. Males aged over 50 were therefore advised to supplement their intake of Vitamin D with pharmacological preparations.

The **Swedish** recommended serving sizes for the energy needs of men and women in the age range 19–60 years with a sedentary lifestyle and little or limited physical activity in their leisure time (physical activity level 1.6). Some discretionary or leeway foods were included in the calculations of the main food groups. For example, sausage meat and pâté were considered discretionary or leeway foods in Australia, but were considered a meat-based food in Sweden.

The recommended numbers of servings and the sizes of these servings were reported as daily or weekly recommendations. In the guidelines these were:

- For grains, between six and eight servings of a 25–30 g slice of bread per day; five servings of 40 g cereal or porridge per week; rice or pasta (amounts not specified) four times per week.
- For starchy vegetables, 175–210 g per day.
- For fats, cumulatively per week, 56–66.5 g liquid margarine; 50–60 g oil; 34–40 g of 80% fat cooking margarine; 55–75 g of 80% fat margarine spread, and 75–100 g of 40% fat margarine.
- For meat and cured meats, 285–360 g lean meat per week, of which less than 10% is fatty meats (such as sausage meat); 380–480 g fatty meats per week; 100–125 g sausage per week; 150–225 g black pudding per month; 105 g liver pâté per week.
- For milk, cheese and other dairy products, 590–980 ml low-fat milk per week; 200 ml yogurt per week and 20 g cheese per day.

In addition, between 13% and 14% of energy intake from leeway or discretionary foods was allowed. These so called 'leeway' foods are estimated to contribute 9% of the total fat allowed, of which 14% is unsaturated fat and 86% is saturated fat. Alcohol is calculated to contribute 1–2% of energy intake. Examples of the recommended number of servings and the size of these servings were: 7 g savoury snacks; 95 g buns, pastries, cakes; 50 g ice cream; 70 g desserts; 123 g sweets; 165 g jam; 231 g fizzy drinks; 15 g sugar and 4 g alcohol per week.

The key targeted messages included, but were not limited to, recommendations to choose 'Keyhole-labelled goods', a labelling system that identifies low-fat and/or high-fibre product in supermarkets and restaurants; eat according to the plate model, which provides a visual aid on optimum proportional distribution of the various food groups; choose low-fat and high-fibre foods; increase fish intake; eat soft fat rather than hard fat; eat plenty of fruit and vegetables. The messages reiterate and build on the dietary advice from previous national-level educational programmes.

US serving sizes resulting from the translation of recommended dietary intake into dietary guidelines were reported by calorie intake.

Examples of serving sizes for the various food groups included:

- For grains, (cereal) a single 1 oz.(28.4 g) slice of bread; 1 oz. uncooked pasta or rice; half a cup of cooked rice, pasta, or cereal; one tortilla (six-inch diameter); one pancake (five-inch diameter); 1 oz. ready-to-eat cereal (about one cup of cereal flakes).
- For servings of vegetables and fruit, one cup. (As the volume of a cup occupied by different vegetables varies, it is not possible to give a representative measure of mass for this food group.)
- For fats, one teaspoon soft margarine; one teaspoon vegetable oil; one tablespoon mayonnaise or one tablespoon salad dressing; for meats and alternatives, 1 oz. (28.4 g) cooked meats, poultry or fish, or one egg.
- For dairy produce and alternatives, one cup of milk or yogurt or 1.5 oz. cheese.

The recommended serving sizes for the total age range and both males and females addressed in the guidelines were:

- A 1.5–5 oz. serving of whole grains and a 1.5–5 oz. serving of enriched grains per day.
- 2–8 cups per week of starchy vegetables.
- 10–34 oz. per week of meat, poultry and eggs.
- 1–5 oz. per week of nuts, seed and soya produce; 2–3 cup servings per day of dairy.

Recommendations regarding the number of calories (and the percentage of recommended calories) of leeway or SoFAS (sugars or fats and added salt) range from 121 calories (8%) of the recommended 1,600 calories intake to 296 calories (19%) of the recommended 3,200 calories intake.

The key targeted messages stated that people should ensure that at least half their grains are whole grains; that they substitute saturated fats with unsaturated oils; use fat-free milk; choose spreads and soft margarines made from oils rather than that stick margarine or butter; use cooking oils instead of solid fats, and fat-trimmed meat.

The **UK (England)** does not provide recommendations on serving sizes stratified according to the age-sex-activity levels of population subgroups. Rather, it provides calculations of segment size based on quantitative guidelines for the consumption of foods within each of the five food groups, so as to ensure a national average diet, which is consistent with the UK Dietary Reference Values (DRVs). Advice is given through the 'eatwell plate', a key policy tool that defines the government's recommendations on a healthy diet. The eatwell plate provides a visual representation of the types and proportions of foods needed for a healthy, balanced diet i.e., plenty of starchy foods, fruit and vegetables; some milk, dairy, meat, fish and other non-dairy sources of protein, and only small amounts of food and drinks that are high in fat and/or sugar. Recommendations are to: eat at least five portions of a variety of fruit and vegetables every day; eat some meat (people who eat more than 90 g red or processed meat per day should reduce their intake to 70 g per day); eat fish (two portions of fish per week, including one portion of oily fish); eat eggs, beans and other non-dairy sources of protein as part of a healthy, balanced diet. The key targeted messages are: eat plenty of bread, rice, potatoes, pasta and other starchy foods every day; choose wholegrain varieties where possible; eat plenty of fruit and vegetables (at least five portions of a variety of fruit and vegetables each day, not including those that count as a starchy food); consume lower-fat options of some milk and dairy foods every day. Finally, eat just a small amount of foods and drinks that are high in fat and/or sugar.

Mapping of Irish Department of health dietary recommendations with recommendations from Australia, Canada and the USA

The number of daily recommended dietary servings for the four food groups – grains; vegetables and fruit; milk and alternatives; meats and alternatives – along with the recommended servings of oils and fats, as well as extra, leeway or discretionary foods, were compared to the recommended servings for Ireland. The rough comparisons were calculated for the female population, aged 19–50 years, who have a sedentary or moderately active lifestyle. Ireland was compared to Australia, Canada and the USA. However, a number of issues need to be considered when comparing FBDGs between two or more countries. Country-specific comparisons do not consider the differences in dietary energy determinants or the differing criteria for categorising food groups.

The inter-country comparison (Ireland compared to Canada and the USA) for a person with a sedentary lifestyle recommended between 6 and 6.5 servings of grains; 5–8 servings of vegetables and fruit; 2–3 servings of milk and alternatives, and between 2 and 3.5 servings of meats and alternatives. It should be noted that the inclusion of the potato on the grains shelf in the Irish recommendations represents a variation in the underlying grouping of grains, vegetables and fruit, which differ to that adopted by the USA or Canada. Ireland and the USA made recommendations on the additional groups of 'oils and fats', and 'extras, leeway or discretionary foods'. No difference was observed with regard to oils and fats, at two servings each per day; however, the Irish allowance on discretionary foods at one serving per day was one-third of the US allowance.

The inter-country comparison (Ireland compared to Australia) for a person with an active lifestyle recommended between 6.7 and 8 servings of grains; 5–9 servings of vegetables and fruit; 3–3.4 servings of milk and alternatives and between 2 and 3.3 servings of meats and alternatives. A two-fold difference was observed with regard to oils and fats, at 2–4 servings each per day. However, the Australian allowance on discretionary foods at 0.5 serving per day was a half that of the Irish allowance.

Differences in the underlying nutritional, socio-political and cultural criteria of bundling foods; the diet-health relationships considered to be of public health relevance; limiting the provision of dietary advice to essential foods only, or making it inclusive of discretionary intake, along with variations in age range grouping, climatic conditions and contemporary food consumption patterns represent just some of the variations that must be considered when seeking to make inter-country comparisons.

Question 3

Fats and carbohydrate seesaw effect

In the late 1980s (the Committee on Medical Aspects of Food Policy) and in the early 1990s, one particular phenomenon was noted in observational studies: there was an inverse linear association between the percentage energy intake of fat with sugars. Simply put, as the percentage of energy from fats in the diet decreased, the percentage of energy from sugar increased, and vice versa. A number of authors, including one systematic review, hypothesised that, in freely chosen diets, reducing energy intake from both fats and sugars at the same time in order to comply with dietary guidelines may be difficult for populations to achieve. The evidence (according to Sugar-Fat seesaw: a systematic review of the evidence) was supportive of an inverse correlation between the percentage of energy from total sugars and the percentage of energy from total fats and, separately, total sugars and unsaturated fats, as well as extrinsic sugars (refined or added sugars) and total fats. However, the percentage energy relationship between sucrose and total fats in the single study identified demonstrated a positive unadjusted correlation. In addition, there was no association between the percentage energy relationship and extrinsic sugars (refined or added sugars) and saturated fats.

Other authors have stated that the inverse relationship is an inevitable mathematical consequence rather than one that is being influenced by dietary choice; in other words, it is an issue of weight rather than proportion. Horgan *et al.* caution that comparing quantity in percentage (energy) terms alone can be misleading, and it is only when absolute values (weight) as well as percentage contribution to energy are examined that the interrelationships between macronutrients (such as fats and sugar) can be studied fully.

Horgan *et al.* in a 2012 paper examined the associations between macronutrient intakes in the diets of adults (n=1,724) participating in the UK National Diet and Nutrition Survey, and again within the same sample adults across different days of the week. As expected, negative correlations were obtained between mean daily percentage energy intakes of fat and total sugars, extrinsic sugars and intrinsic sugars (all $p < 0.001$). Specifically, as one decreased, the other increased. However, when mean daily macronutrient intakes were expressed in weight grams per day, these were all positively correlated (all $p < 0.001$): as one increased the other increased. Mean estimated correlations between macronutrient intakes (grams per day) for each individual across the days of the week were also positive, indicating (according to the authors) an absence of the fat-sugar seesaw effect. Within the Nutrient Databank, the correlation between fats and total sugar (grams per 100 g of food) was weakly positive ($p = 0.006$). Only when examining the correlation between fat and sugar(s) between individuals in percentage terms (% energy) was the fat-sugar seesaw evident; in all other methods used, the correlations between fats and sugar(s) indicated that they increased or decreased together.

The authors conclude that examination of the effects of using percentage energy values to describe the macronutrient composition demonstrated that the fat-sugar seesaw is only an inevitable mathematical, not dietary, consequence.

According to Horgan *et al.*, the question that needs to be asked is: Why is this percentage energy seesaw effect important? Horgan *et al.* states 'it matters if it affects the population's health status and also if people cannot assimilate more than one message in food dietary guidelines'.

Relationships between carbohydrates and/or fats and heart disease

In 2010, the European Food Safety Authority reported in its dietary reference values for nutrient intake document that 'evidence is still inconclusive on the role of **glycemic index** and **glycemic load** in maintaining weight and preventing diet-related **disease**' or chronic diseases in particular **coronary heart disease (CHD)**.

Glycaemic load and glycaemic index and their relationship with cardiovascular disease CVD

Two systematic reviews which undertook a meta-analysis to evaluate the relationship between glycaemic load (GL) and glycaemic index (GI), and their relationship with CVD (CHD or stroke), reported that high-GI and GL diets were significantly associated with CHD events in women, but not in men. High GI and GL were not significantly associated with stroke in the one meta-analysis where the outcome was examined.

Fats substituted with each other and carbohydrates

Jakobsen and colleagues (2009) investigated associations between energy intake from monounsaturated fatty acids (MUFAs), polyunsaturated fatty acids (PUFAs), and carbohydrates and risk of CHD, while assessing the potential effect-modifying role of sex and age. Using substitution models, their aim was to clarify whether energy from unsaturated fatty acids or carbohydrates should replace energy from saturated fatty acids, in order to prevent CHD. This was a follow-up study in which data from 11 American and European cohort studies were pooled. The outcome measure was incident CHD. The relationships suggest that replacing saturated fatty acids with PUFAs, rather than MUFAs or carbohydrates, prevents CHD over a wide range of intakes. A subsequent review in 2010 examining the

relationship between polyunsaturated fat and saturated fats concluded that randomised control trials demonstrated that consuming PUFAs in place of saturated fatty acids reduces CHD events by 19%.

Dietary saturated fat with risk of CHD and stroke

Siri-Tarino *et al.* (in 2010) completed a meta-analysis to summarise the evidence related to the association of dietary saturated fat with risk of CHD and stroke in prospective epidemiologic studies. Twenty-one studies were identified as being suitable for inclusion in the review; of these, 16 had CHD as an outcome and 8 had stroke as an outcome; three studies examined both outcomes. The authors conclude that there is no evidence in this analysis that the intake of saturated fat is not associated with an increased risk of CHD and stroke.

Replacement of fats with low- and high-GI carbohydrates

Jakobsen and *et al.* (in 2010) examined the risk of myocardial infarction (MI) associated with a higher energy intake from carbohydrates and a concomitant lower energy intake from saturated fatty acids using substitution models. The finding of this study suggest that replacing saturated fatty acids with carbohydrates with low-glycemic index values (such as wholegrain products) may be associated with a possible lower risk of MI, whereas replacing saturated fatty acids with carbohydrates with high-glycemic index values (such as refined sugars) is associated with a higher risk of MI.

Conclusion

Broadly speaking, the Department of Health's dietary recommendations do not differ substantially from the dietary recommendations of other countries (Australia, Canada and the USA), which have populations with similar characteristics (specifically, age-sex-activity levels). However, there are some exceptions to these recommendations, as the following examples show:

1. The Department of Health dietary recommendations allow extrinsic fats and oils for people with sedentary lifestyles. By contrast, the Australian and Canadian dietary recommendations do not allow extrinsic fats and oils for people with such lifestyles.
2. The Department of Health dietary recommendations allow discretionary foods for people with sedentary lifestyles, whereas the Australian and Canadian dietary recommendations do not allow high-sugar and high-fat foods for people with such lifestyles.
3. In Ireland, potatoes are included on the grains shelf. By contrast, they are classified as starchy vegetables in Australia, Canada and the USA, and this may result in a possible overestimate of the amount of grains consumed in Ireland, compared to the amount of grains consumed in Australia, Canada and the USA.
4. Fruit and vegetables intake recommendations on appear somewhat lower for the Irish diet compared to the Australian, Canadian and US diet.
5. The majority of countries recommend that more than half of the grain intake should be whole grain rather than refined grain, and the images used in these countries' health promotion materials demonstrate this practice. Australia recommends eating wholegrain products rather than discretionary products after engaging in moderate exercise.
6. In Australia and Canada, the emphasis is on polyunsaturated fats rather than monounsaturated fats or saturated fats.

The fats-sugar seesaw relationship is a fallacy and does not merit any further consideration. However, avoidance of saturated fatty acid accumulation by reducing the intake of both carbohydrates and fats with a high glycaemic index is more effective in the prevention of CVD than reducing saturated fatty acid intake alone. The key messages in the FBDGs with respect to dietary fats are that they should be eaten in small amounts, and saturated fats should be substituted for, or replaced with, unsaturated fats (particularly PUFAs) or complex carbohydrates.

Chapter 1: Background and purpose

The Health Promotion Policy Unit in the Department of Health has developed a pictorial food pyramid as a nutrition education tool designed to inform the Irish population about the types and amounts of different foods that should be eaten in order to ensure a healthy, balanced diet. In addition, healthy eating guidelines or tips are used alongside the food pyramid, in order to ensure a healthy lifestyle.

The food pyramid and healthy eating guidelines are updated as new evidence becomes available; the last formal review was carried out in 2010. Currently, there is discussion in the nutrition literature about the optimum balance between carbohydrates and fats in a healthy diet. In Ireland, the current recommendation, based on realistic targets, is that the calorie content of a balanced diet is obtained from protein (at 15%), fats (30–35%) and carbohydrates (55–65%). The recommended daily calorie intake for active adults ranges from 1,800 calories (women) to 2,200 calories (men). For sedentary adults, the recommended calorie intake is lower. This evidence review will be used to ensure that the food pyramid is consistent with appropriate international recommendations, and will be used in the formulation of the new National Nutrition Policy.

- Healthy eating guidelines will be informed by this evidence review. The target population is healthy Irish children aged five years and over (but excluding people who are obese or who require special diets).
- The outcomes anticipated by the Health Promotion Policy Unit are:
 - up-to-date evidence that demonstrates the appropriate composition of the food pyramid, with a particular focus on simple and complex carbohydrates and fats and oils
 - evidence to clarify the issue of the fats and carbohydrate seesaw effect.

Chapter 2: Review questions

The review questions are:

1. What are the recommended number of servings, serving or portion sizes, and calorie content for simple and complex carbohydrates, individually and combined; based on the most recent scientific evidence?
 - a. With respect to this question, we have interpreted simple and complex carbohydrates as refined and unrefined carbohydrates, as this is in line with current practice.
 - b. We have reported the amount of energy that is required from carbohydrates as calorie contributions recommended in the international literature.
 - c. We have measured carbohydrate intake, taking into account grains, fruit, vegetables and refined sugar consumption recommendations in a number of omnivore diets or food pyramids.
2. What are the recommended number of servings, serving or portion sizes, and calorie content for fats and oils (including monounsaturated and polyunsaturated as a proportion of saturated fats), based on the most recent scientific evidence?
 - a. We have reported the amount of energy that is required from fats as calorie contributions recommended in the international literature.
 - b. We have measured fat intake taking into account the meat, fish, dairy, added oils and fat and non-essential high fat products recommendations in a number of omnivore diets or food pyramids.
3. What is the ratio of, and inter-replacement possibilities for, carbohydrates and fats, based on the most recent scientific evidence? Is there an ideal ratio? Is there a seesaw effect? Is there a replacement argument that allows substitution between carbohydrates and fats?
 - a. We present a summary review of the fats and carbohydrate seesaw effect, and the most recent evidence on the link between carbohydrates and fats and cardiovascular disease.

As the nutrients, carbohydrates and fats are featured in foods on a number of the pyramid's shelves, we have covered all relevant shelves in the pyramid. It is not possible to comment on intake of these macronutrients without taking account of carbohydrate and fat intakes from shelves such as dairy, meat or discretionary foods.

Chapter 3: Methods

Search strategy

This review set out to identify the most recent scientific evidence on the recommended number of servings, serving or portion sizes, and calorie content for 'refined and unrefined carbohydrates', and 'fats and oils' individually and combined. Throughout the review, we used the term lipids or fats to refer to 'fats and oils' as a nutrient group, as this is the practice in formal nutrition literature.

A multi-pronged search strategy was used to:

1. develop an understanding of the subject matter
2. identify key search words
3. develop a working framework to address the questions
4. identify data sources to gather information on serving or portion sizes, and calorie content of the named foods.

Background

This review set out to find data to answer the three questions on the evidence relating to 'carbohydrates' and 'fats' on the food pyramid shelves, as requested by the Department of Health (DoH) (Figure 1).



Figure 1 The Irish Department of Health Food Pyramid, 2010

Two of the three questions concerned current advice on serving or portion sizes, and calorie content of carbohydrates and fats (in the form of foods) within the food pyramid. The third question concerned the current evidence on the issue of fats and the carbohydrate seesaw effect. The questions posed by the DoH required different sources and types of information, in order to provide robust answers; this required initial scoping of the literature to understand the background to and processes by which an agreement on the types and amounts of carbohydrates and fats to be included in the diet are determined. We used an iterative approach to locate information, as recommended by Brunton *et al.*,¹ who suggest that '...when it is unclear at the beginning of a review what specific types of study [or

data] are needed or where the review is proceeding along an investigative line, from the findings in one report to inform where and how to look for the next potentially relevant reference in order to create a sampling frame'... iterative searching is the most appropriate empirical method.

Questions 1 and 2

To begin the process, a two-pronged approach was adopted. First, prior knowledge from the researchers on the role of a range of international organisations in the area of nutritional advice was tapped into, targeting and retrieving expert publications from the websites of the World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO) on carbohydrates and fats. Second, the keywords 'food pyramid', and the term 'food-based dietary guidelines' identified from examination of the international organisations' publications, were used in a Google search. The words and terms were linked with a range of different countries' names, and each phase was individually pursued. This process identified a third international food-related organisation, 'the European Food Safety Agency' and its national-level websites for a range of countries on some or all of the following areas:

- food pyramids or other related food graphics
- food-based dietary guideline publications
- food-based dietary guideline educational and/or interactive websites
- additional related documentation.

Examination of these information sources allowed the development of a framework to understand FBDGs development. The areas of interest within the framework included:

- systematic literature reviews on diet-health relationships
- identification of national-level survey data on population food consumption patterns, anthropometry and morbidity profile
- national food composition databases
- the development of recommended dietary intake
- the development of FBDGs.

In conjunction with the literature identified in the national and international reports, an additional systematic review of a range of nutritional peer-reviewed journals for the period 2010 to February 2014 was undertaken. Information on the historical development of, approach to, and the nature of the evolution of FBDGs was extracted.

Speculation on what was intended by the terms 'simple and complex carbohydrates' and 'fats and oils' were addressed. Ambiguities in Question 1 and Question 2 were dealt with in the following manner. Carbohydrates were grouped according to their degree of processing i.e., as refined and or unrefined products, as this is often indicative of how quickly the sugar is digested and absorbed. This reflects the relevant terminology as currently employed, rather than the underlying biochemical constituents of the group. The questions also required consideration of the foods on the bottom carbohydrate shelf, carbohydrate- containing foods on other shelves, and additional carbohydrate-rich foods on the top shelf.

Speculation on what was intended by the term 'fats and oils' were also addressed. The ambiguities of Question 2 suggested a range of interpretations:

- One interpretation required consideration of fats and oils on the 'fifth shelf' of the DoH Food Pyramid, representing the products of fats and oils, such as butter or oil olive, i.e., products derived from but extrinsic to foods in general.
- A second interpretation required consideration of fats and oils on the 'sixth shelf' of the DoH Food Pyramid. These foods predominantly comprise manufactured foods, such as pizzas, cakes and crisps, where the 'intrinsic' nature of the fats and oils is the result of their addition to individual foods at the time of manufacture.
- A third interpretation required consideration of fats and oils as the macronutrient fat, which is distributed in varying quantities across almost all natural unprocessed foods, and thus intrinsic to each food – i.e., consideration of the fat content of foods on shelves 1 to 4.
- The fourth interpretation required consideration of all three denotations of fats and oils, i.e., taking account of products on all shelves.

Finally, as identified above, the distribution of fats and oils across a range of natural unprocessed foods suggested that examination of the role of protein in the diet was also required, although this was not requested in the original DoH review questions. Therefore, the protein-rich foods on shelf 1 and shelf 4 of the DoH Food Pyramid (representing dairy, meats and alternatives products) were included for consideration.

The HRB interpretation of Question 1 and Question 2, as presented in the notes under each question in Chapter 2, was influenced by the statistical basis used to determine dietary recommendations and strongly determined how the HRB answered the questions. Given these considerations, it was decided to consider:

1. carbohydrates, taking into account their complexity and their distribution across all shelves on the food pyramid
2. fats and oils, taking into account the distribution of fats and oils across all shelves on the DoH Food Pyramid.
3. proteins, especially animal-based proteins, due to the presence of fats in many protein-rich foods
4. both carbohydrates and fats and oils in leeway foods, which are highly processed manufactured foods (for example, chips fried in oil, as highlighted on shelf 6 of the DoH Food Pyramid)
5. fats and oils products that are extrinsic to, but may be added to, foods (for example, olive oil, as highlighted on shelf 5 of the DoH Food Pyramid)
6. fats and oils as products that are intrinsic to natural, unprocessed foods (for example, the fat content of red meat on shelf 4 and milk products on shelf 3).

In other words, we decided to consider the food pyramid in its totality and not just with respect to specific shelves.

Due to the form of the initial questions and the assessment of identified papers, and also in order to justify the adopted approach, it was deemed necessary to provide context and background on food composition and the dietary modelling process. Context and background are presented before findings are reported on the international guidance on recommended number of servings, serving or portion sizes, and calorie content for carbohydrates and fats and oils. Consequently, before presenting information on issues such as portion and serving sizes, this evidence review includes:

- a brief overview of the 'biological materials of human consumption', their distribution in various individual foods and food classes or groups, as determined by specific common characteristics

- a brief description of the biochemistry of the macronutrient carbohydrates identified for consideration of fats and oils
- a description of the various food groups, taking into account their carbohydrate, fat and protein content and also taking into account foods that are rich in these macronutrients.

The findings also indicated the need to report on:

- how dietary (nutrient and energy) requirements are calculated
- how information on nutrients are translated into FBDGs.

Finally, a range of European, Canadian, New Zealand and US food composition databases are presented. Data from the US food composition database are used to illustrate the number of groups into which foods can be bundled, as well as illustrate some different underlying grouping or classification methods. US data are chosen because they provide good examples of factors of interest in understanding the role of not only nutritional content but also a range of socio-political influences in grouping foods.

In the next phase of the search we used a country-specific approach to identify the national-level recommendations and guidelines on servings, serving or portion sizes and calorie content. In line with the dietary data reported in the DoH publication *Your guide to healthy eating using the food pyramid*, we concentrated on predominantly 'western' omnivore diets. We excluded reporting on vegetarian, Mediterranean, vegan, pasta or rice-based diets, as it became apparent that individual modelling of the data was required for each diet type. The countries retained for reporting were Australia, Canada, Sweden, the United States of America and the United Kingdom (England). The criteria for retention reflect the contemporary nature of reporting (i.e., the most recent country-specific reports), the suitability of published data, use of data from a country's population which, broadly speaking, consumes foods similar to Ireland; the final criterion for retention was regional comparisons, in order to allow comparisons when taking account of climatic considerations.

The following data were retrieved and, where relevant, plotted against the Irish DoH recommendations:

- recommended international, regional and national macronutrient ranges (World Health Organization, Food and Agriculture Organization of the United Nations, Nordic countries, North America, Australasia and Europe)
- food groups and their composition
- portion and serving size recommendations (Australia, Canada, Sweden and the USA)
- key food messages.

In addition to the country-specific reporting outlined above, dietary recommendations from the United Kingdom were also reported; however, the manner of their presentation precludes researchers from making meaningful comparisons with other countries. National-level FBDGs, as derived from the statistical dietary models, were identified and used to determine portion and serving size recommendations for each food group. Finally, key dietary messages were identified; these represented factors of specific public health importance, taking into account country-specific morbidity rates, food consumption patterns and any age-specific or sex-specific micronutrient deficiencies that may have arisen during the modelling process.

Finally, we made personal contact with individuals in a number of international or national bodies in cases where issues of clarification arose, or where additional unpublished information was required.

More detail on these individual search approaches and key search terms are summarised in Tables 43–47 in Appendix A:

- Table 43 presents the international organisation and the publications from their website that has been identified as relevant in the context of this review.
- Table 44 presents the country and search terms that were entered into the Google search engine in order to locate country-specific national-level organisations that are responsible for determining national-level FBDGs.
- Table 45 lists the countries and the publications from which data were retrieved for inclusion in the review.
- Table 46 lists the time parameters (2010–13) and the peer-reviewed journals retrieved from the Open University website, using the search term 'nutrition'. Each journal issue was perused, in order to identify articles on carbohydrates, fats and/or food pyramids. In addition, relevant articles were selected for use in this review.
- Table 47 presents the food composition database from which primary data were retrieved in order to plot the composition of a range of food groups and food types.

Question 3

Fats and carbohydrate seesaw effect

We searched the PubMed database using the following words:

- **seesaw**[All Fields] AND ("carbohydrates"[MeSH Terms] OR "carbohydrates"[All Fields] OR "sugar"[All Fields])

This yielded 13 results, including one systematic review. The recent systematic review, (Sugar-fat seesaw: a systematic review of the evidence [Epub ahead of print]), was used as an index paper to identify key historic papers that reported on the progress of the fat-carbohydrate seesaw effect over time, including:

- Gibney M, Sigman-Grant M, Stanton Jr JL and Keast DR (1995) *American Journal of Clinical Nutrition*; 62(1):178S-193S

The remaining 12 papers were either only slightly relevant or not relevant at all. None were used in the final review.

An additional search using the search terms mentioned above, i.e., CINAHL with Full Text database, yielded the following two articles which examined both percentage energy and weight in grams of the carbohydrates and fats consumed:

- Mazlan N, Horgan G, Whybrow S and Stubbs RJ (2006) Effects of increasing increments of fat- and sugar-rich snacks in the diet on energy and macronutrient intake in lean and overweight men *British Journal of Nutrition*, vol 96, no. 3, pp. 596-606.
- Horgan GW and Whybrow S (2012) Associations between fat, sugar and other macronutrient intakes in the National diet *Nutrition Survey Nutrition Bulletin*, 2012 Sep; 37 (3): 213-23.

Relationship between carbohydrates and/or fats and heart disease

In 2010, the European Food Safety Authority² reported in its dietary reference values for nutrient intake document that 'evidence is still inconclusive on the role of **glycemic index** and **glycemic load** in maintaining weight and preventing diet-related **disease** or chronic diseases, in particular **coronary heart disease (CHD)**. It is generally accepted that trans fats increase the risk of CHD.'

Using the terms 'glycemic index', 'glycemic load' and 'diet-related disease' and using the terms 'fats, carbohydrates and diet-related disease' to guide a search strategy, we found a number of systematic reviews and cohort studies examining this relationship. We limited the search to the years 2009 to 2014, as the 2010 European Food Safety Authority² had completed an extensive review of literature to examine the diet and disease relationship.

The HRB authors found 12 reviews or cohort studies and we used six of them. We excluded one cohort study (as it was included in one of the meta-analysis), two Asian studies (similar results) and three text-based reviews.

When reporting the relationships, we used systematic reviews that employed meta-analysis or pooled analysis, where available, and in preference to the cohort studies. In addition, we concentrated on European and American studies rather than Asian studies, as these are more relevant to Ireland. We used one cohort study where there was no systematic review of the topic.

Presentation and layout of findings

This review addresses the role of carbohydrates and fats (including oils) in the diet. It does so in the following manner:

The report is presented in six chapters: Chapters 1–3 present details of the background, the review questions and the methods employed. This is followed by a chapter on nutrition (Chapter 4); a chapter answering questions 1 and 2 (Chapter 5) and a chapter answering question 3 (Chapter 6).

Chapter 4 contains six sections:

- Section 1 provides background on the chemical composition of macronutrients, including carbohydrates and fats. It also presents the main food sources of these nutrients.
- Section 2 presents the distribution of nutrients across a range of foods, and demonstrates that nutrients may be distributed in varying quantities in most foods. This identifies the difficulty of considering macronutrients rather than food types, and in turn the difficulty of considering one shelf on the food pyramid without considering its interaction with other shelves, in order to create a complete and balanced diet.
- Section 3 provides an overview of food composition databases.
- Section 4 presents the factors that determine food and nutritional requirements.
- Section 5 presents the process for developing FBDGs and the methods for designing diets.
- Section 6 covers recommended macronutrient intake ranges.

Chapter 5 provides answers to questions 1 and 2, and contains three sections:

- Section 1 covers the international and national recommended macronutrient intake ranges.

- Section 2 presents the national-level dietary recommendations for five countries: Australia, Canada, Sweden, the United States of America (USA) and the United Kingdom (UK).
- Section 3 compares the recommended dietary intake in Ireland, Canada and Australia, using specific age groups and activity levels in females as an exemplar for all age-sex groups. This approach was adopted, as databases with the raw data required to undertake a more accurate statistical analysis are not in the public domain, and the additional statistical modelling needed in order to correctly identify macronutrient ranges would have required a different study approach. Therefore, the 'best fit' approach that we could adopt was the use of published composite measures to undertake descriptive comparison. Issues to be considered in determining the degree of precision required in order to interpret the mapping exercise are detailed at the end of each section.

Chapter 6 provides the answer to Question 3 and contains two sections:

- Section 1 covers what is known about the seesaw effect.
- Section 2 presents recent evidence on the link between carbohydrates and fats with cardiovascular.

Chapter 4: Nutrients, food and its composition, requirements and guidelines

Section 1: Nutrients and food groups

Proximates, the collective term used for the 'biological materials of human consumption', comprise ash (including minerals and vitamins), moisture (water), carbohydrates, fats and proteins. Macronutrient is a collective term, and is used to identify the biological materials carbohydrates, fats and proteins. Macronutrients are present in varying quantities in vegetables; fruit; grains; meats, including poultry; fish; nuts and seeds; dairy produce. In general, individual foods are grouped under four umbrella terms. These are grains (also called cereals), fruit and vegetables, meats and alternatives, and milk and alternatives. Foods may be grouped according to a range of criteria (see next paragraph). Food groups are not mutually exclusive and often exhibit substantial overlap. For example, soya beans, a legume, can be included in the 'vegetables' group (soya beans) or in the 'meats and alternatives' (soya mince) or the 'milk and alternatives' (soya milk) groups. Moreover, soya may be considered to be a fat, as the plant is classed as an oilseed rather than a pulse by the Food and Agriculture Organization of the United Nations (FAO).

A range of criteria can be applied to group foods. The number of food groups also varies – from the four commonly employed umbrella terms cited previously – to up to as many as 25 food groups. The increasing number of food groups reflects a more specific demarcation of food, such as considering 'fruit and vegetables' separately as 'fruit' and 'vegetables', or further stratifying 'meats and alternatives' into 'meats', 'poultry' 'fish' and 'nuts and seeds'. Regardless of how these criteria are used to cluster food groups, the grouping of food is based on the predominance of a specific macronutrient. Other classification criteria include: a product class (such as bread, pasta, muffin which is classified as a grain product) or the agricultural base from which food originated. (for example, wheat is classified as a grain.) Alternatively, classification criteria may be based on consumers' uses of those foods. (For example, legumes may be placed in the food group titled 'meats and alternatives', as consumers use legumes as a meat substitute.) However, if food classification is based on nutritional content, legumes would be grouped with 'grain products'.

The macronutrient fat, which is found in almost all foods (referred to here as 'intrinsic fat'), may also be considered as a product extrinsic to foods (referred to here as 'extrinsic fat'). Extrinsic fat is considered not to be a food group; rather, it stands outside the food groups. For example, while the fat in meat is regarded as extrinsic fat, fat in the form of butter, although derived from animal products, is regarded as an extrinsic fat, i.e., outside the 'meats and alternatives' or even the 'milk and alternatives' food group. How this is dealt with in determining the dietary intake is explored under 'dietary design' later in this review.

For reporting purposes, we present findings using the four terms 'grains', 'fruit and vegetables', 'meats and alternatives', and 'milk and alternatives'. However, country-specific variation in labelling methods has curtailed our capacity to be constantly faithful to such labels. This will be observed in the results presented in Chapter 5 and in the supporting tables in Appendix D (Tables 54, 57 and 59). It should be noted that the deviation from the four umbrella groups reflects the country-specific expert bodies' labelling criteria. The variation in the inclusion and exclusion criteria precluded a direct comparison, thus necessitating a rather qualitative approach to comparing findings.

Examples of the issues highlighted above are plotted in Figure 2, using US National Nutrient Database data. A total of 8,463 different foods are grouped into 25 food groups, as determined by: nutritional content (for example, cereal grains and pasta); cultural considerations (for example, American Indian/Alaskan native foods), and life stage (for example, baby food).

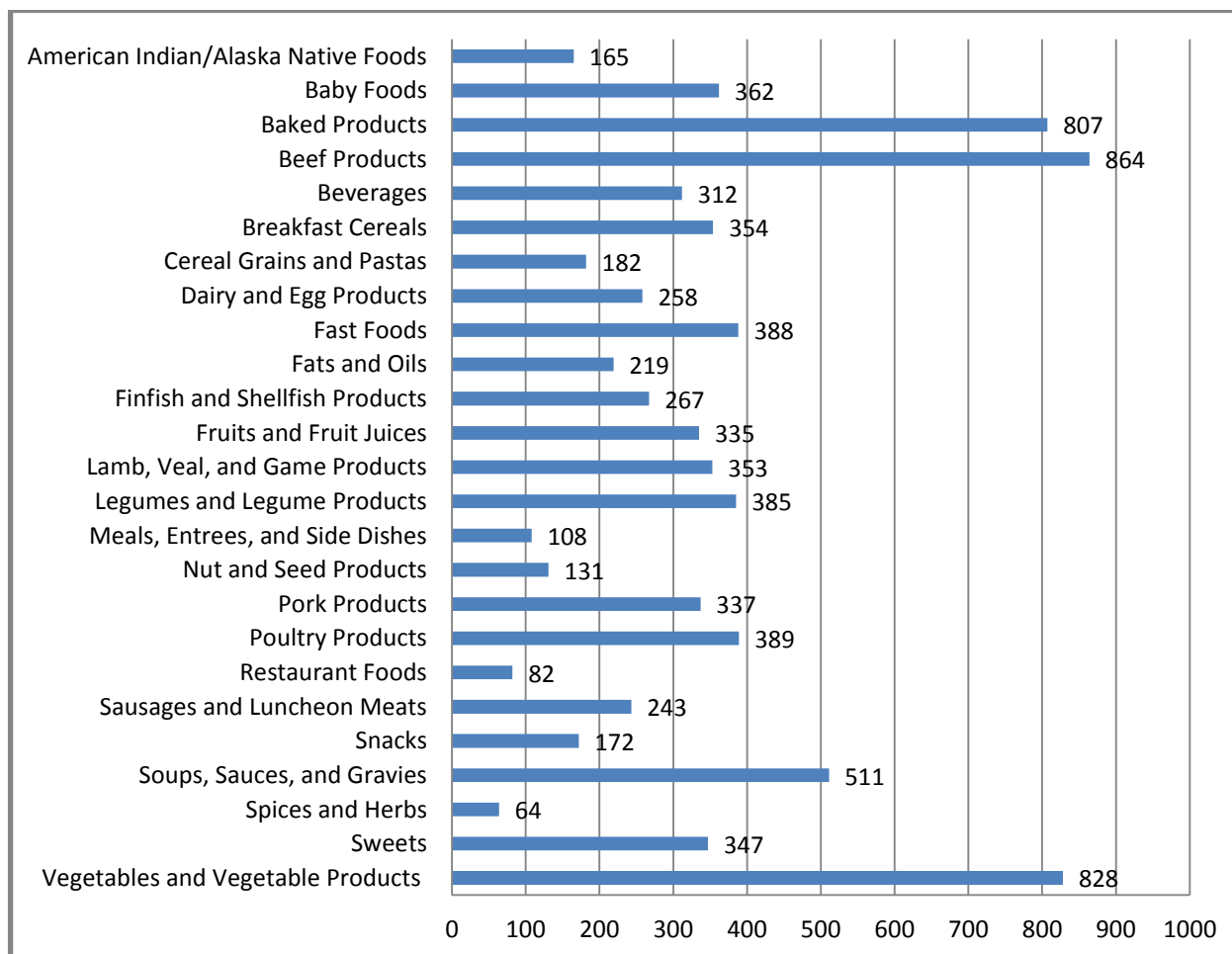


Figure 2 The U.S. Department of Agriculture 2013 National Nutrient Database for standard reference on the composition of raw, processed and prepared foods. Number of food groups (25) and number of foods within each group

Produce-based food groups comprise different combinations of macronutrients (carbohydrates, fats and proteins), and their specific combinations may differ for each country, thereby giving rise to overlaps and differences in food groups, and thus to variations in the comparability of food groups. A brief summary of the chemical composition and sources of the three macronutrients are given below.

Carbohydrates are chemical compounds that contain carbon (C), hydrogen (H), and oxygen (O) atoms. They are composed of sugars chemically joined together; they are also known as saccharides and are technically hydrates of carbon.³ The term 'carbohydrate' is defined as polyhydroxy aldehydes, ketones, alcohols, acids, their simple derivatives and their polymers having linkages of the acetal type. The primary classification of carbohydrate is based on chemistry, i.e., the character of individual monomers (e.g., monosaccharides), degree of polymerisation (DP) and type of linkage (α or β^2), as recommended

by the Food and Agriculture Organization/World Health Organization Expert Consultation in 1997.⁴ This divides carbohydrates into three main groups: sugars (mono- and di-saccharides, DP 1–2), oligosaccharides (DP 3–9) and polysaccharides (DP ≥10) (see Table 1).

In 2006, an FAO/WHO update on some of the key issues relating to carbohydrates in human nutrition endorsed the primary classification recommended by the 1997 Expert Consultation, but acknowledged that a chemical classification, although providing a practical basis for measurement and labelling, did not allow a simple translation into nutritional effects.⁵ Each class of carbohydrate has overlapping physiological properties and effects on health. Carbohydrates can be classified based on their digestion and absorption in the small intestine rather than their chemical characteristics. Digestible carbohydrates are absorbed and digested in the small intestine; non-digestible carbohydrates are resistant to hydrolysis in the small intestine, and reach the human large intestine where they are at least partially fermented by the commensal bacteria present in the colon. The term 'dietary fibre' refers to either some or all of the constituents of non-digestible carbohydrates, and may also include other quantitatively minor components, e.g., lignin, that are associated with non-digestible carbohydrates in the plant cell walls (see paragraphs 2.27 to 2.34 of the Science Advisory Committee on Nutrition's paper considering different dietary fibre definitions).⁶

Table 1 Chemical classification of carbohydrates (FAO/WHO, 1998)

Carbohydrates		
Sugars (DP 1-2)	Oligosaccharides (DP 3-9)	Polysaccharides (DP > 9)
Subgroups		
Monosaccharides	Malto-oligosaccharides	Starch
Disaccharides	Non-digestible oligosaccharides	Non-starch polysaccharides
Sugars alcohols/polyols		
Components		
Glucose, galactose, fructose	Maltodextrins	Amylose, amylopectin, modified starches
Sucrose, lactose, maltose Sorbitol, mannitol	Raffinose, stachyose, fructo- oligosaccharides	Cellulose, hemicellulose, pectins, hydrocolloids (gums)

Foods containing refined carbohydrate are often highly processed. Such foods include table sugar, honey, sweets, soft drinks, biscuits, breads, crackers, jams, jellies, pastas and breakfast cereals. Many processed foods – for example, sweets, soft drinks, biscuits, ready meals and breakfast cereals – contain high amounts of added sugars (usually in the form of simple monosaccharides or disaccharides). In essence, these added sugars are simple carbohydrates. Unrefined foods – for example, beans, tubers, wholegrain and unrefined fruit – usually contain natural carbohydrates. Whole grains and wholegrain foods comprise three edible layers of the grain, seed or kernel. Each layer provides a unique combination of nutrients. Dietary fibre is the indigestible portion of carbohydrate derived from plants, and is found in the waste products of animals that eat dietary fibre. Fibre is a type of carbohydrate that the body cannot digest (see Table 2).

It should be noted while this chapter summarises current knowledge on nutrients, food composition requirements and guidelines reporting on the recommended daily or weekly intake has limit. The precise of recommendations maybe vary by time range or for specific persons. It has been suggested that it is not possible to set a recommended daily intake for carbohydrates (either collectively or individually) for humans over one year of age.⁷

Table 2 Amount of fibre in foods

Food group	Serving average (mean)	fibre g/serving
Cooked dry beans (legumes)	0.5 cup	8.0
Dark green vegetables	0.5 cup	6.4
Whole grains	28 g (1 oz.)	2.4
Orange vegetables	0.5 cup	2.1
Starchy vegetables	0.5 cup	1.7
Fruit	0.5 cup	1.1
Other vegetables	0.5 cup	1.1
Meat	28 g (1 oz.)	0.1

While the term 'sugars' refers to monosaccharides and disaccharides, various terms are used to define the types of sugars described in dietary recommendations. A summary of the different definitions for sugars is given in Table 3.

Table 3 Different definitions used for sugars in dietary recommendations

Food group	Definition
Non-milk extrinsic sugars* – UK	Sugars not contained within the cellular structure of a food, and sugars in milk and milk products.
Free sugars* – WHO	Sugars added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey, syrups, fruit juices and fruit concentrates.
Added sugars – US	Sugars and syrups that are added to foods during processing and preparation.
Added sugars – EFSA	Sucrose, fructose, glucose, starch hydrolysates (glucose syrup, high-fructose syrup, isoglucose) and other isolated sugar preparations used as such, or added during food preparation and manufacturing.

** The only difference between non-milk extrinsic sugars and free sugars is that non-milk extrinsic sugars include 50% of the fruit sugars from stewed, dried or canned fruit,⁸ but free sugars include none.*

Examples of carbohydrate-rich foods within the three food group types (vegetables, fruit, and grains and cereals) along with processed or commercially produced carbohydrate-rich foods are presented in Figure 3.

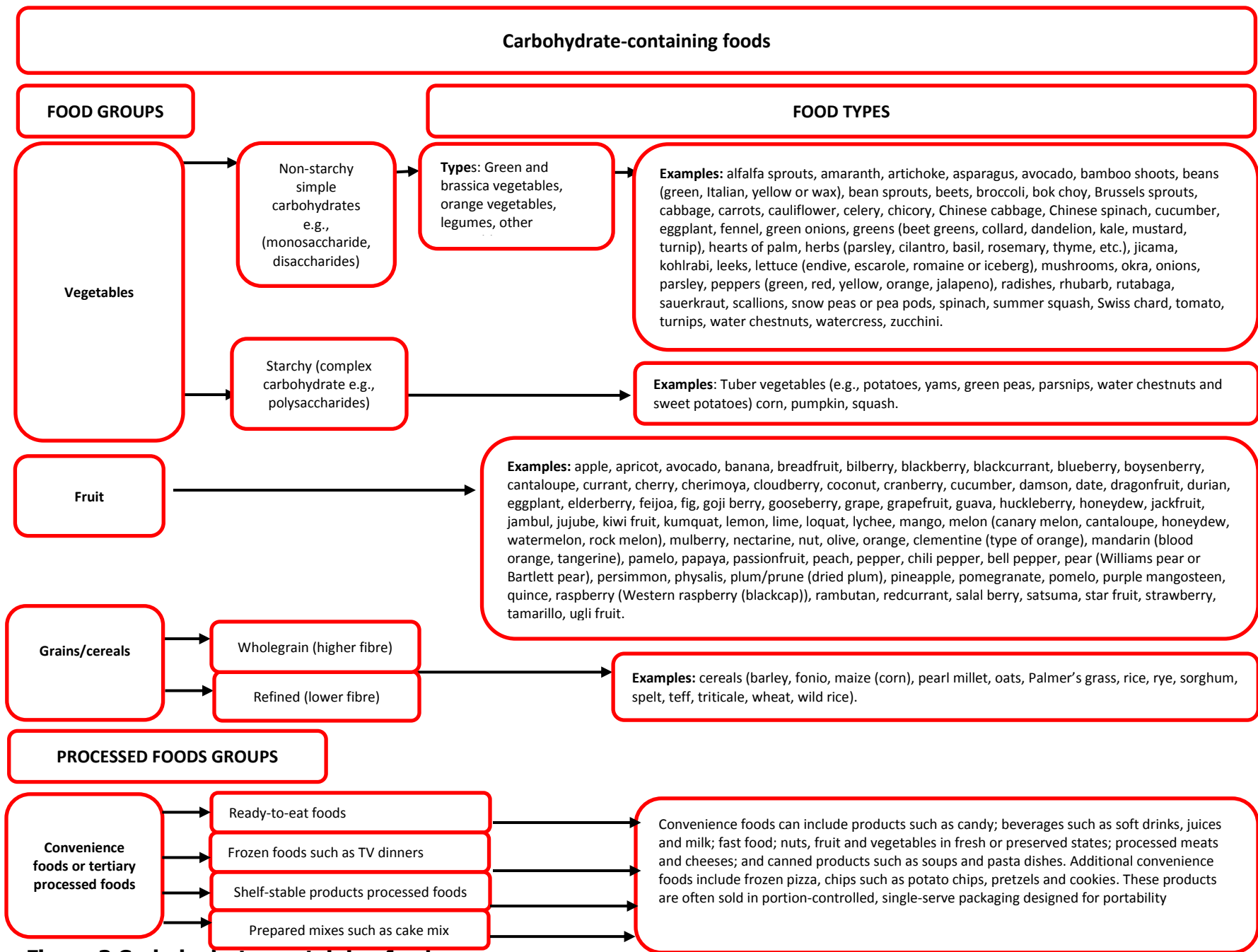


Figure 3 Carbohydrate-containing foods

Although the words 'oils', 'fats', and 'lipids' are all used to refer to fats, in reality, fats are a subset of the **lipids** group. The term 'Lipids' is used to refer to both liquid and solid fats. 'Oils' usually used to refer to fats that are liquid at room temperature, and these contain mainly unsaturated fats (see Figure 4).

Some examples of foods containing high amounts of polyunsaturated fat include soya bean oil, corn oil, safflower oil, walnuts, sunflower seeds, sesame seeds, pumpkin seeds, flaxseed, fatty fish, soya milk and tofu. Examples of foods containing a high proportion of monounsaturated fats include olive oil, canola oil, sunflower oil, peanut oil, sesame oil, avocados, olives, nuts and peanut butter. The term 'fats' is usually used to refer to fats that are solid at room temperature, and these contain mainly saturated fats. Some examples of foods that contain saturated fat include high-fat cuts of meat, whole-fat dairy products, ice cream, palm oil, coconut oil, and lard. Trans fats are solid fats, and are found mainly in commercially baked or prepared foods such as pastries, cookies, cakes, pizza dough, packaged snack foods, stick margarine, vegetable shortening, deep-fried foods and candy bars. Vitamins A, D, E, and K are fat soluble, meaning they can only be digested, absorbed, and transported in conjunction with fats (see Figure 4).

Protein is a nutrient needed by the human body for growth and maintenance, and comprises amino acids. Amino acids are found in **animal sources**, such as meats, milk, fish, eggs, cheese and yogurt. Proteins are also available via **plant sources**, such as whole grains, pulses, legumes, soya, fruit, nuts and seeds. Vegetarians and vegans can obtain adequate essential amino acids by eating a variety of plant proteins.

Foods that are protein rich are animal-based or vegetable-based produce. Animal-based foods include meat and flesh foods (such as beef, lamb, veal, pork, poultry and seafood finfish and shellfish), and non-meat produce (such as eggs). Vegetable foods include tofu (formed by coagulating soya milk made from soya beans) and legumes, such as beans, nuts, peas and lentils. However, as many protein-rich foods are also rich in fats, consideration of any dietary intake that is concerned with fat consumption must also examine the contribution that protein-rich foods make to fat intake (see Figure 5).

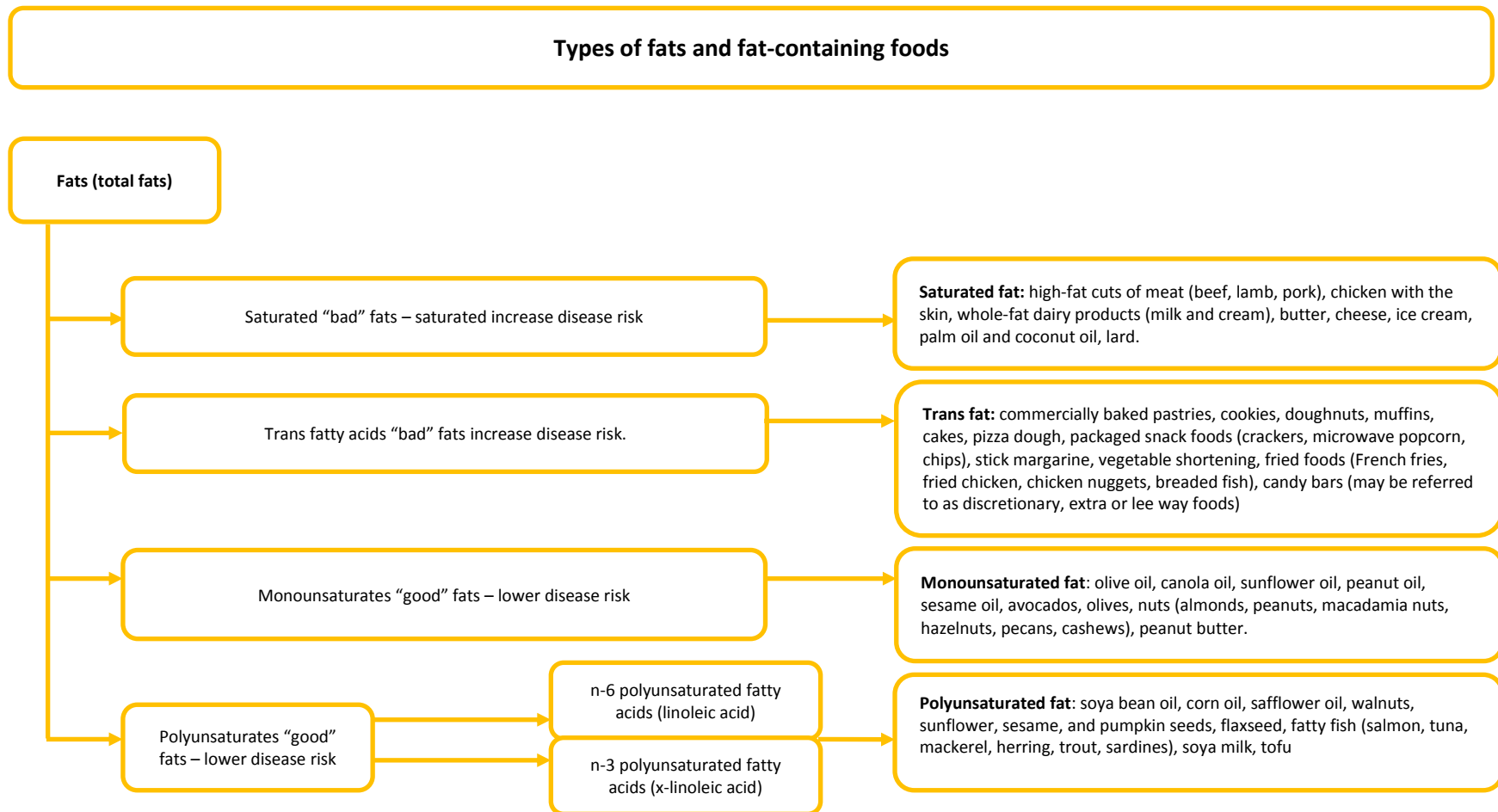


Figure 4 Types of fats and oils and fat-containing foods

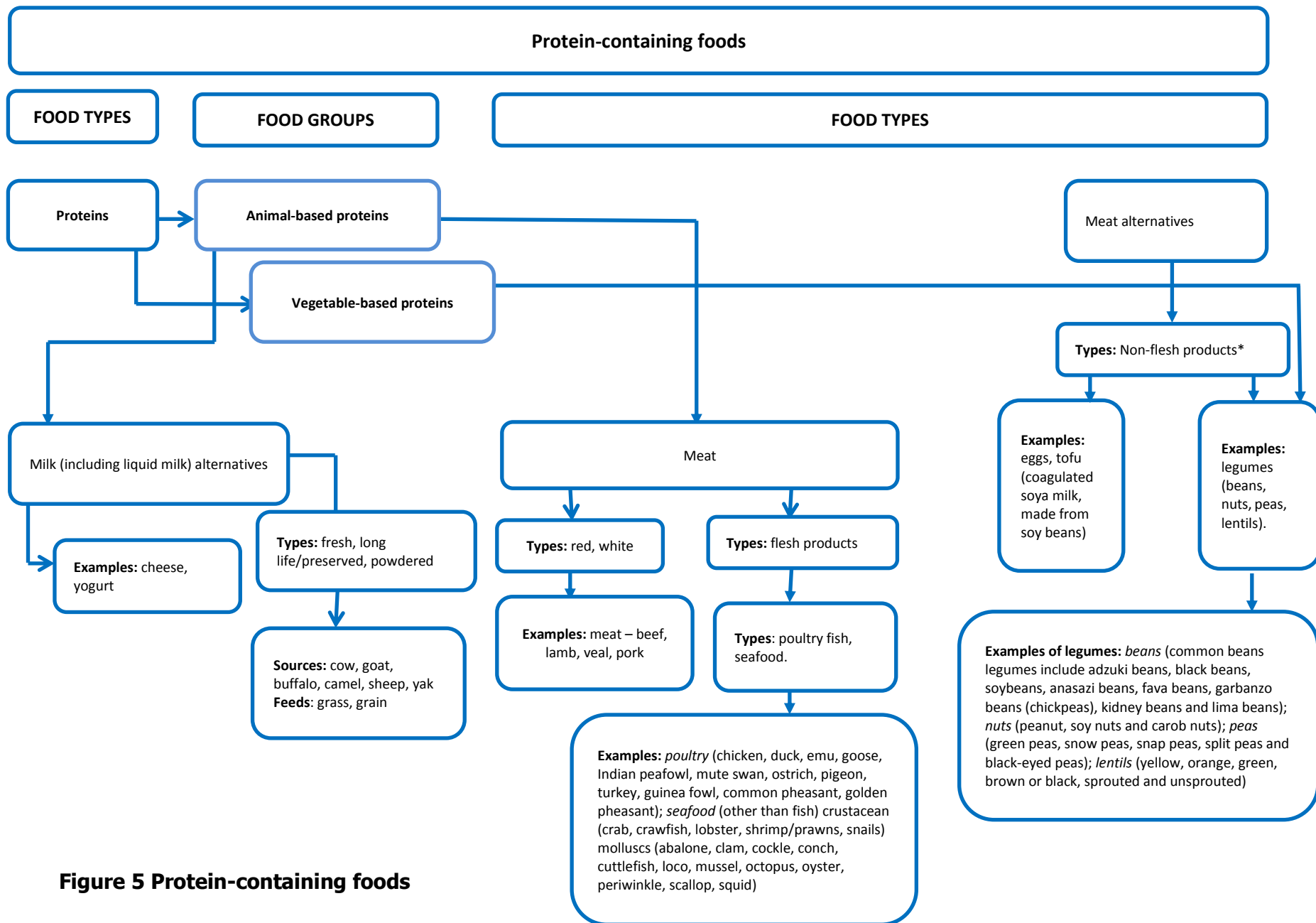


Figure 5 Protein-containing foods

Section 2: Distribution of nutrients in food groups

Section 2 presents the distribution of nutrients across a range of foods, using primary data from the U.S. Department of Agriculture's 2013 National Nutrient Database for Standard Reference.⁹ The section presents values on the composition of a variety of food examples, as well as raw, cooked and processed foods from the food groups (i.e., grains, vegetables, fruit, meats and alternatives, fish and shellfish, and dairy produce). The presented data demonstrate how the mix of macronutrients in individual foods means that a practice of choosing specific foods as proxies of specific macronutrients has some limitations. It also highlights the difficulty of taking into account one shelf on the food pyramid without considering other shelves, in order to create a complete and balanced diet. The data demonstrate the difference between the smaller number of (generally four or five) food groups compiled from food produce, and the substantially greater number of food groups (i.e., a total of 25) that can result from adopting other forms of classification, such as by food products.

The data show how quantities of carbohydrates are found on the vegetables, fruit, and meat food pyramid shelves, as well as on the grains and starchy vegetables shelf (see Figure 6). In addition, the data show how quantities of fat are found on the grains shelf (see Figure 7), fruit shelf (see Figure 8) meat shelf (see Figure 9), fish shelf (see Figure 10), dairy shelf (see Figure 11), as well as on the fats and oils shelf (see Figure 12).⁹ All commercially prepared oils (predominately unsaturated fats) also contain between 8% and 28% saturated fats.

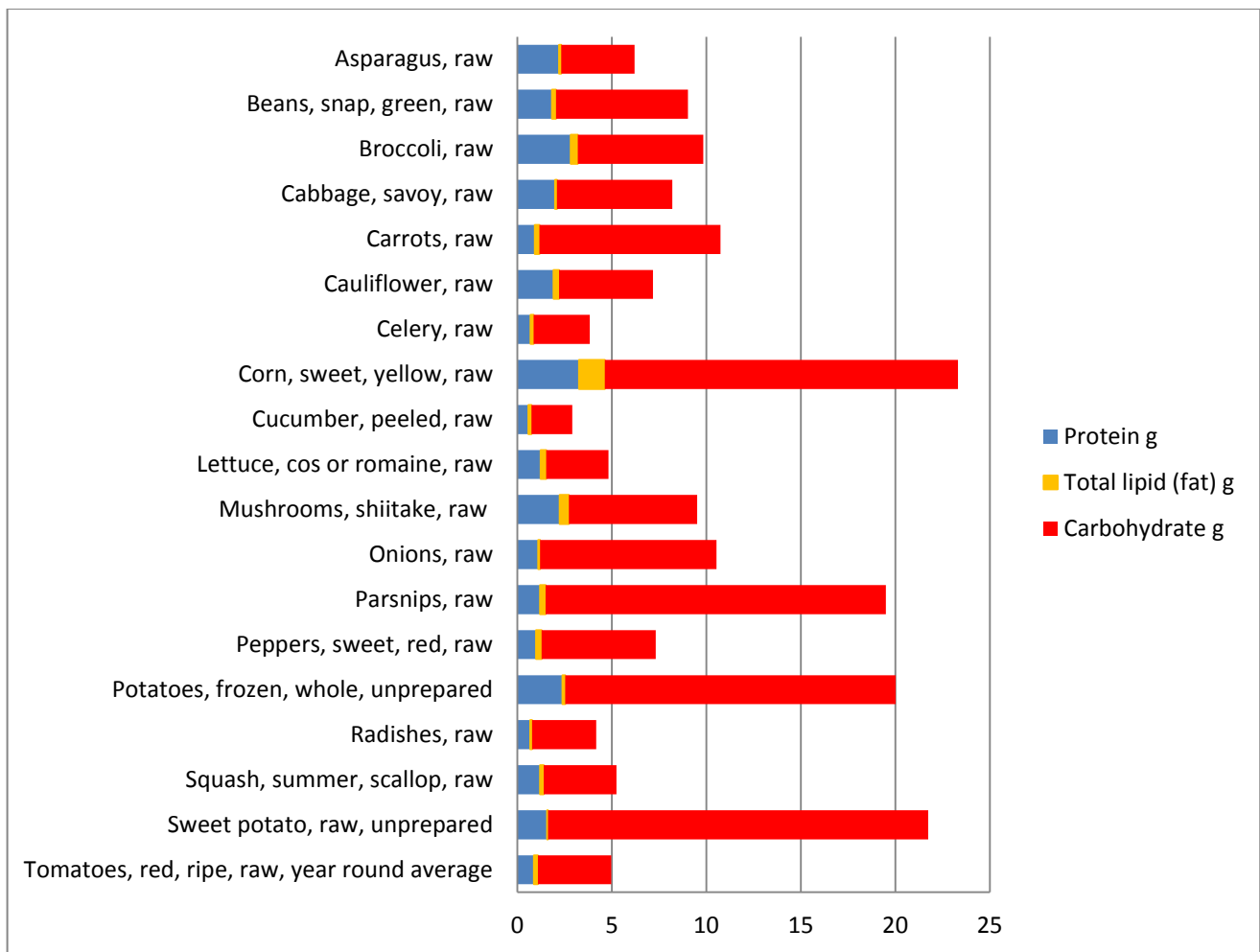


Figure 6 Number of grams of carbohydrates, total lipids and protein per 100 g serving of vegetables

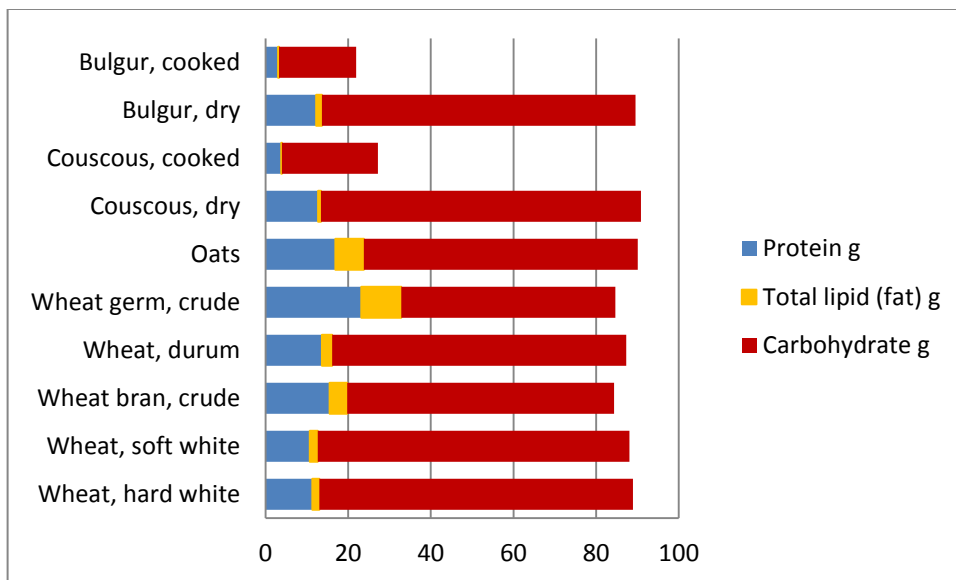


Figure 7 Number of grams of carbohydrates, total lipids and protein per 100 g serving of grains

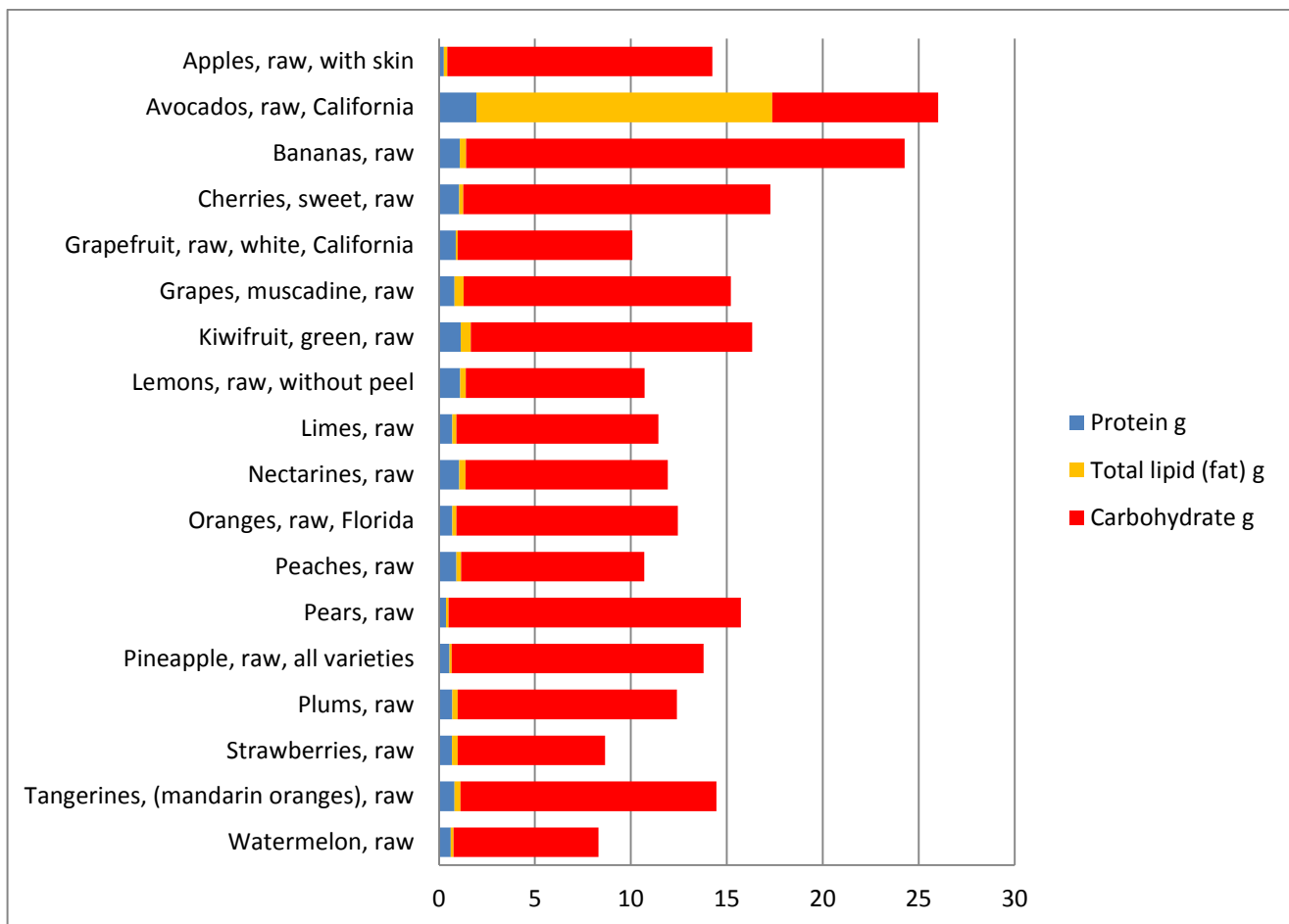


Figure 8 No of grams of carbohydrates, total lipids and protein per 100 g serving of fruit

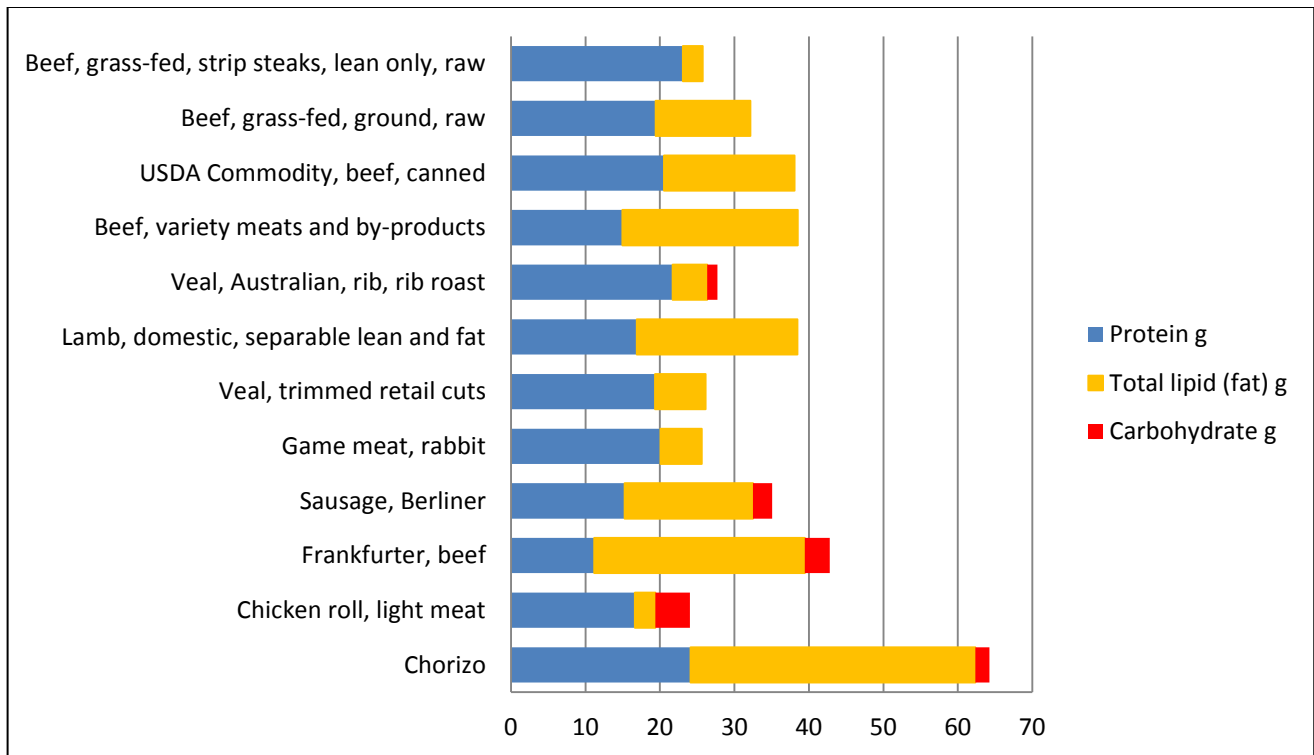


Figure 9 Number of grams of protein, total lipids and carbohydrates per 100 g serving of beef produce; lamb, veal and game produce, and sausages and luncheon meats

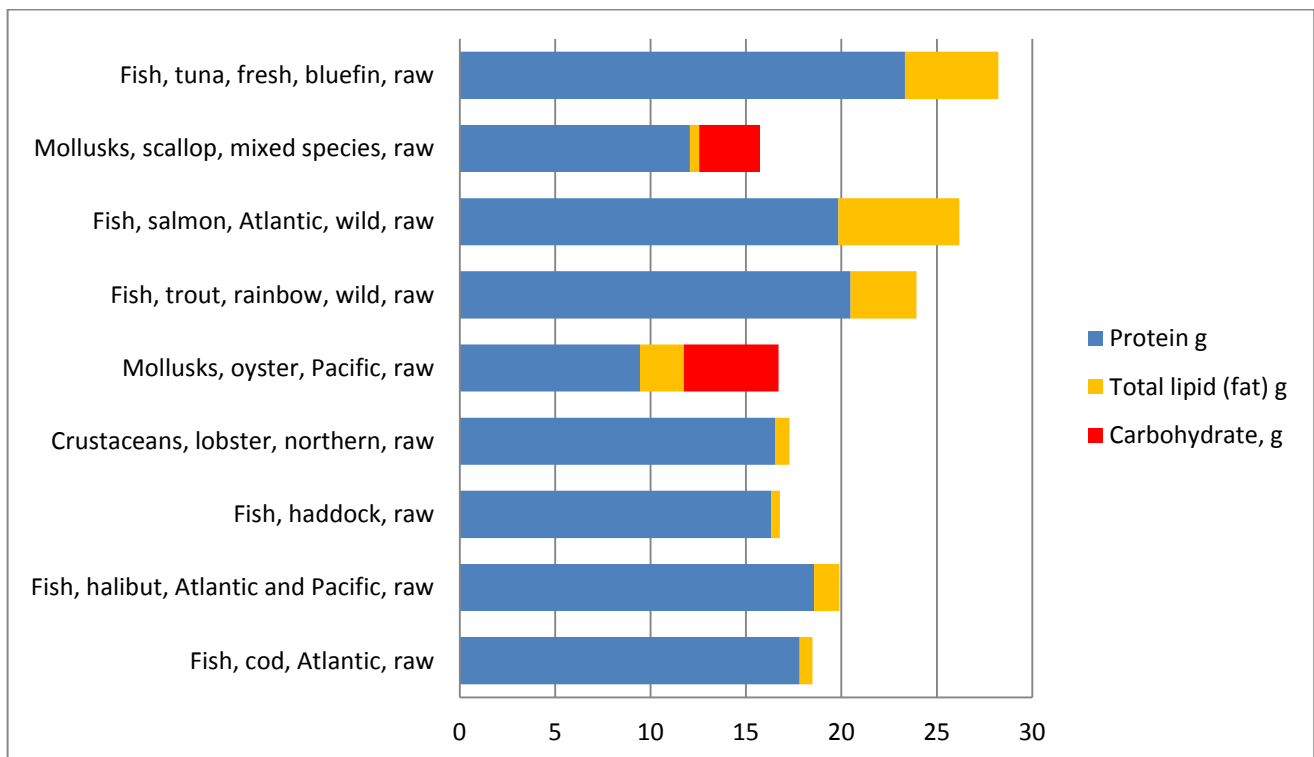


Figure 10 Number of grams of protein, total lipids and carbohydrates per 100 g serving of finfish and shellfish produce

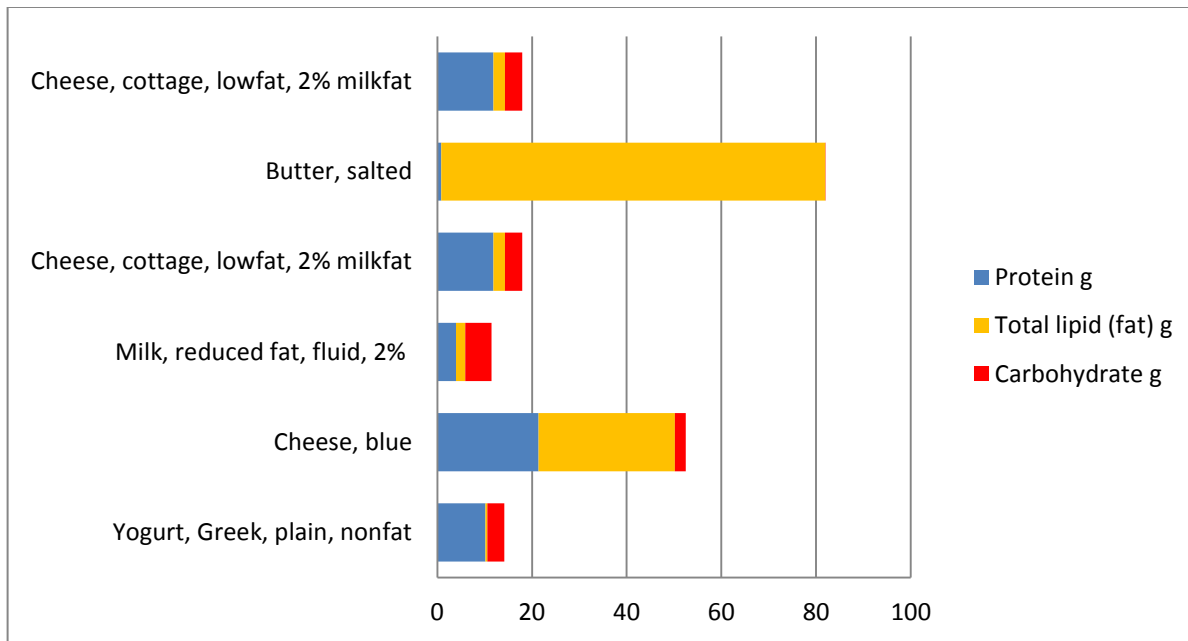


Figure 11 No of grams of protein, total lipids and carbohydrates per 100 g serving of dairy produce

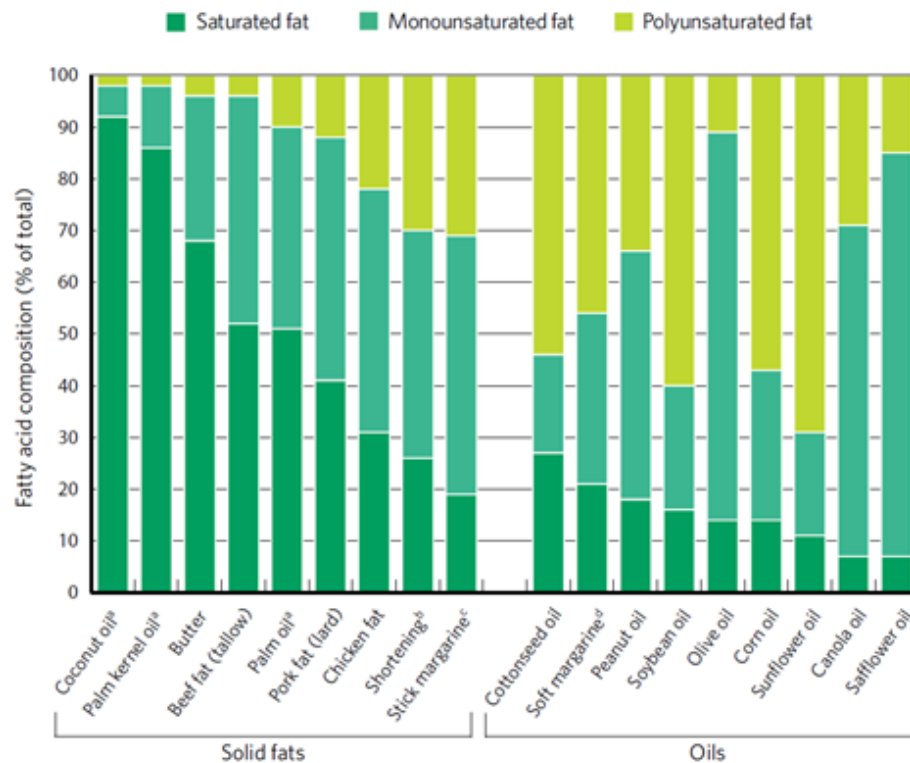


Figure 12 Fatty acid profile of solid fats and oils

The section demonstrated the variation in nutrient content of the main produce food groups and also demonstrated the variation in nutrient content that may be observed in various food products,

depending on their methods of preparation. The content of raw, unprocessed food may be different to that of cooked food, and may be much different to processed products derived from the unprocessed produce, whether cooked or uncooked. Examples of how the cooking process affects nutritional content was observed in relation to the carbohydrate content of grains as demonstrated by bulgur wheat (Figure 7). Examples of how the manufacturing process affects nutritional content was observed in relation to the lipid content of grains as demonstrated in the wheat example (Figure 9). It also shows how, even within shelves, the nutrient values of foodstuffs differ according to different preparation methods. For example, the values for produce such as apples or potatoes 'with skin' differ from those of produce 'without skin', and 'fat-trimmed' meat differs from 'fat-untrimmed' meat.

To summarise this section, quantification of the distribution of the macronutrients of proteins, fats and carbohydrates across a range of food groups (vegetables, fruit, grains/cereals, meats and alternatives, seafood and dairy produce) are presented. This demonstrates the heterogeneous composition of each food group with regard to the three macronutrients; it also demonstrates the distribution of these macronutrients within the specific food that is part of these food groups, thus indicating the limitation of focusing on specific foods as representing a specific macronutrient. This is in line with the WHO recommendation that FBDGs portray nutrients as foods, and that the guidelines express nutritional facts in everyday language. How this issue has been dealt with in determining dietary intake is addressed in subsequent sections of this report.

Section 3: Food composition database

Food composition tables or databases are resources providing detailed information on the nutritional composition of foods. They contain information on a range of components, including macronutrients, minerals, vitamins and energy. Table 4 presents an example of the macronutrient (protein, fats and carbohydrate) food composition per 100 g of edible portion for a range of fruit (grapefruit, grapes and guava).¹⁰

Table 4 Composition of foods per 100 g edible portion

Food*	Protein g	Fat g	Carbohydrate g	Energy kcal	Energy kJ
Grapefruit, raw	0.8	0.1	6.8	30	126
Grapefruit, canned in juice	0.6	Trace	7.3	30	120
Grapefruit, canned in syrup	0.5	Trace	15.5	60	257
Grapes, average	0.4	0.1	15.4	60	257
Guava, raw	0.8	0.5	5.0	26	112

Only macronutrients are reported on in this table. The other proximates of ash (for example, minerals and vitamins) and water are excluded.

Food composition databases are the fundamental information resource for nutrition science and are used to assess nutrient intake at the individual, regional, national or international level. The European Food Information Resource (EuroFIR 2008) has established a common standard for the identification and description of foods in European food composition databases, and allows the application of state-of-the-art concepts that facilitate systematic data collection, database linkage and exchange of food composition data.¹¹ EuroFIR collaborates with 30 partner/national food composition database compilers across Europe, including one based at University College Cork (see Table 5).

Table 5 EuroFIR (European food information resource) partner/national food composition database compilers (accessed on 1 September 2014)

Country	Institution	Database name	Status
Austria	UVI	German "Bundeslebensmittelschlüssel"	
Belgium	NUBEL (vzw)	NIMS	online
Bulgaria	NCH	FCTBL_BG (food composition tables – Bulgaria)	
Canada	Government of Canada	Canadian Nutrient Files	online
Czech Republic	Institute of Agricultural Economics and Information and Food Research Institute	Czech Food Composition Database	online
Denmark	DTU Food National Food Institute	Danish Food Composition Databank	online
Finland	THL National Institute for Health and Welfare	Fineli	online
France	ANSES French agency for food, environment and occupational health and safety	CIQUAL French food composition table	online
Germany	MRI Max Rubner-Institut	German Food Code and Nutrient Data Base	online
Germany	MedPharm	Souci-Fachman-Kraut Food Composition and Nutrition	online
Greece	Hellenic Health Foundation	Composition tables of foods and Greek dishes	online
Greece	Medical School of Crete	Food Composition Tables of Greek Foods	online
Iceland	MATÍS ISGEM (The Icelandic Food Composition Database)	ÍSSEM	online
Ireland	UCC	Irish Food Composition Database	online
Israel	BGU	BGU	online
Italy	INRAN	Banca Dati di Composizione degli Alimenti	online
Italy	IEO Interneto (Istituto Europeo di Oncologia)	Food Composition Database for Epidemiological Studies in Italy	online
Lithuania	NNC Interneto	Respublikinis Mitybos Centras – EuroFIR Food Classification	online
Netherlands	RIVM National Institute for Public Health and the Environment	NEVO	online
New Zealand	The New Zealand Institute for Plant & Food Research Limited and the Ministry of Health	New Zealand Food Composition Database	online
Norway	UiO	Norwegian Food Composition Tables	online
Poland	NFNI	Food Composition Tables	online
Portugal	INSA Instituto Nacional de Saude	Tabela de Composição dos Alimentos – INSA	online
Serbia	IMR Centre of Research Excellence in Nutrition and Metabolism	Serbian Food and Nutrition Database	online
Slovakia	FRI Ministry of Agriculture and Rural Development of the Slovak Republic	Slovak Food Composition Data Bank	online

Country	Institution	Database name	Status
Spain	UGR	Base de Datos Española de Composición de Alimentos – RedBEDCA	online
Sweden	NFA Livsmedelsverket National Food Agency	NFA Food Composition Database	online
Switzerland	ETHZ federal Department of Home Affairs	Swiss Food Composition Database	online
Turkey	TUBITAK	Turkey is currently developing a new Turkish food composition database system	
UK	IFR Food Standard Agency	McCance and Widdowson's The Composition of Foods integrated dataset	online

The US food composition database, which contains 8,463 food groups, is the largest example in this report of a food composition database and these data were used in the analysis presented in this review.

Section 4: Nutrient determinants, diet design and physical activity level scales

Nutrient determinants and diet design

In the literature, the key factors that determine nutrient requirements are identified as age, sex and physical activity level. In general, population-based dietary advice is targeted at healthy individuals or those with only mild metabolic disturbances, and does not cater for the specific needs of pregnant/breastfeeding women and persons with morbid conditions. Figure 13 presents the micronutrients and macronutrients essential for healthy growth and development. The micronutrients are vitamins, minerals and organic acids; the macronutrients are carbohydrates, fats and proteins.

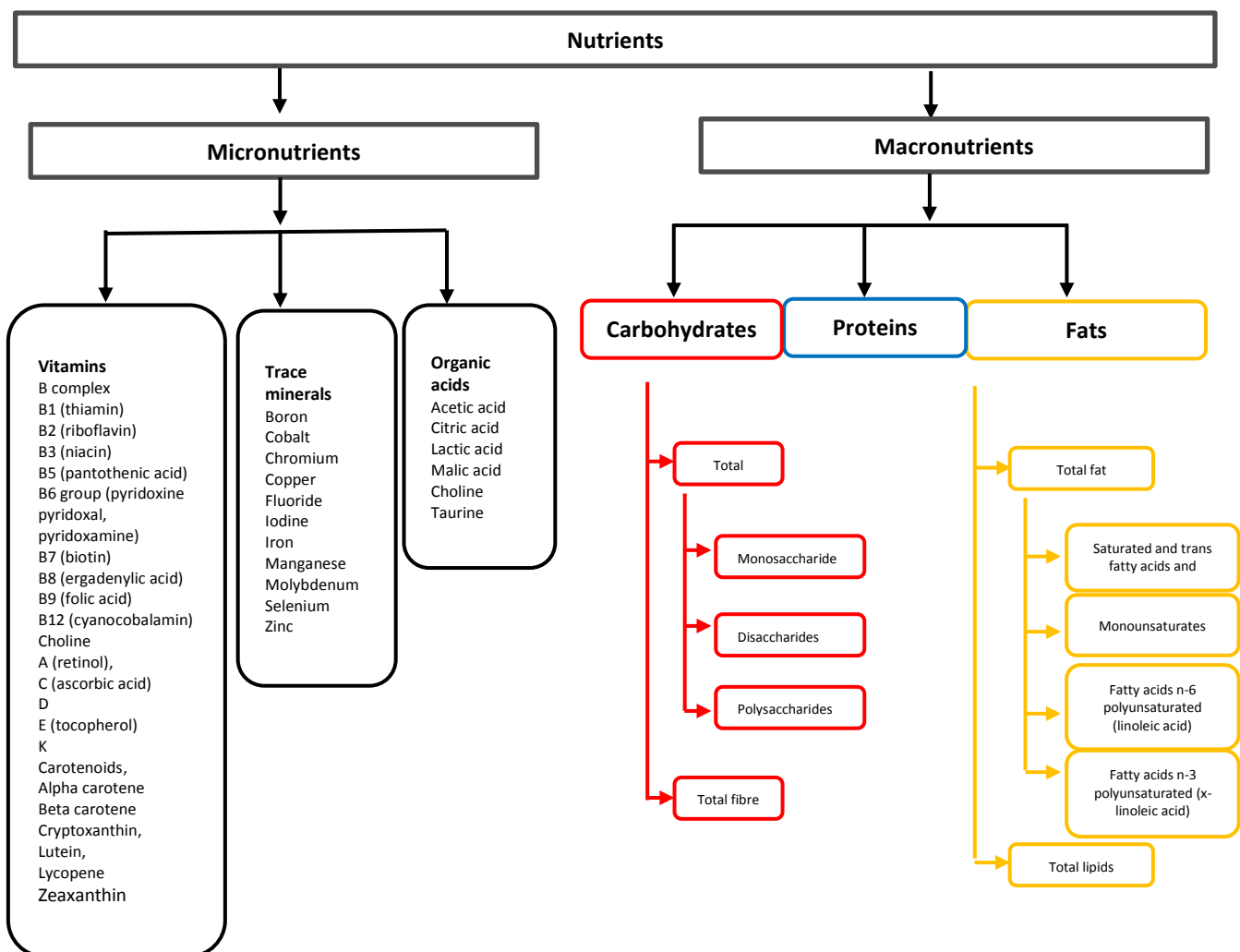


Figure 13 Micronutrients and macronutrients, types and a sample of components

When determining population-based diets, the dietary intake requirements of both micronutrients and macronutrients are calculated taking account of age-sex-activity levels. Failure to achieve the right balance will result in an excessive or deficient intake. Energy is measured in kilocalories (often written as calories) or kilojoules. One kilocalorie is equivalent to 4.18 kilojoules (kJ). The average amount of energy released from one gram of food ranges from approximately 16.7 kJ/g of carbohydrate or protein to 29.3 kJ/g for alcohol and 37.7 kJ/g for fats (see Table 6).

Table 6 Energy yielded from nutrients

Nutrient	Kilocalories of energy per gram	Kilojoules of energy per gram
Carbohydrate	4	16.7
Fats and oils	8.8	37.7
Protein	4	16.7

The basal metabolic rate (BMR) is the lowest amount of energy required to keep the body alive. The BMR represents about 45–70% of daily energy expenditure, depending on age, sex, body size and composition.¹² Physical activity is the most variable determinant of energy need and is the second largest user of energy after BMR. Table 7 presents the estimated daily calorie requirement for people who are not physically active.

Table 7 Estimated daily calorie requirement for people who are not physically active (sedentary)

Sex	Age	Estimated daily kilocalories for those who are not physically active	Estimated daily kilojoules for those who are not physically active	Estimated daily megajoules for those who are not physically active
Children	2–3 years old	1,000	4,180	4.18
	4–8 years old	1,200–1,400	5,016–5,852	5.016–5.852
Girls	9–13 years old	1,600	6,688	6.688
	14–18 years old	1,800	7,524	7.524
Boys	9–13 years old	1,800	7,524	7.524
	14–18 years old	2,200	9,196	9.196
Women	19–30 years old	2,000	8,360	8.36
	31–50 years old	1,800	7,524	7.524
	51+ years old	1,600	6,688	6.688
Men	19–30 years old	2,400	10,032	10.032
	31–50 years old	2,200	9,196	9.196
	51+ years old	2,000	8,360	8.36

Micronutrient requirement levels identified from the literature include summary measures and lower or upper intake micronutrients limits. The micronutrient and macronutrient dietary intake requirements are derived using statistics modelling, working with predefined parameters. General population micronutrient intake parameters and energy determinants are summarised in Figure 14 and described in Table 8.

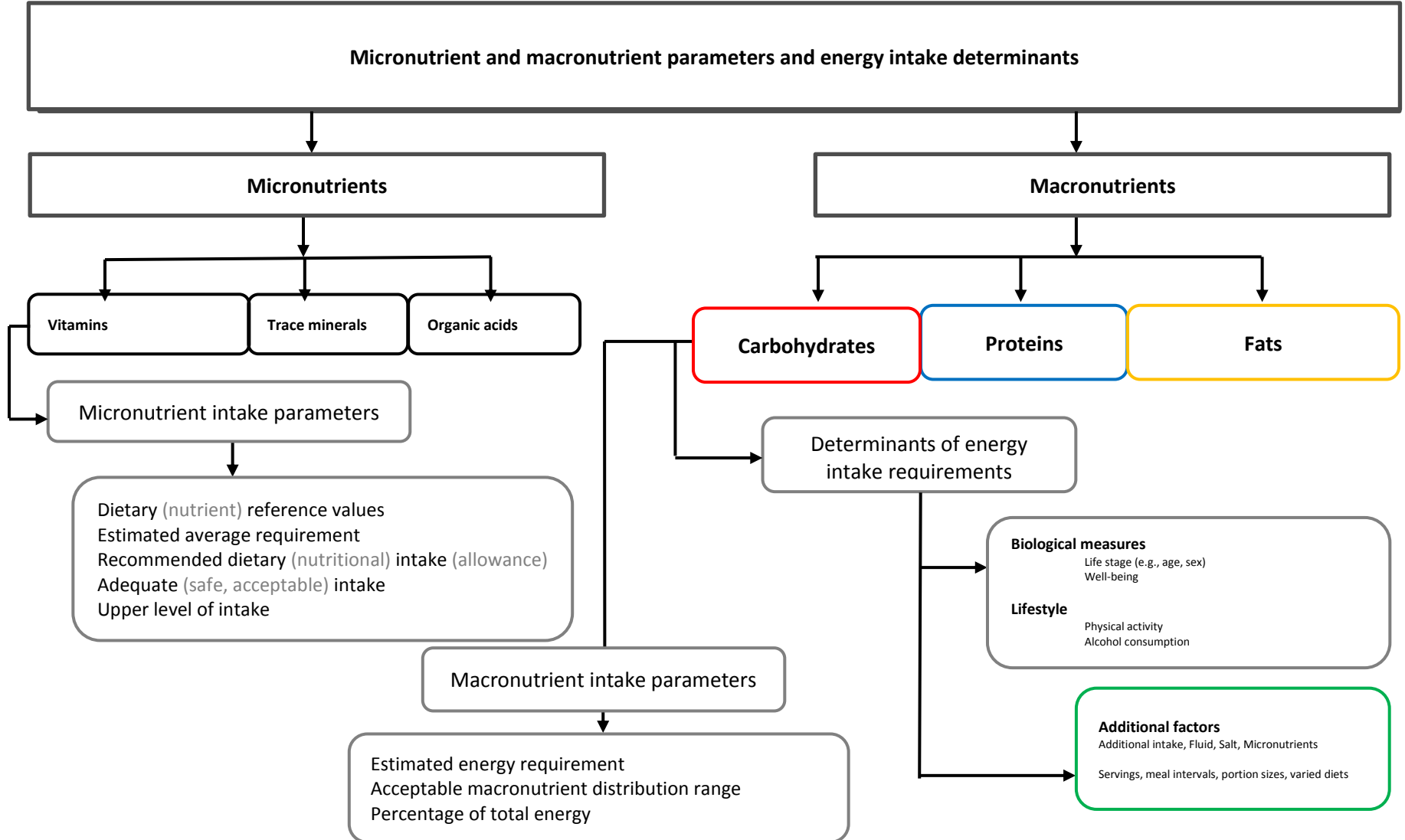


Figure 14 Micronutrient and macronutrient parameters and energy intake determinants

Table 8 Terms and description of micronutrient and macronutrient parameters

Country-specific terms	Country or organisation	Description
Dietary reference values (DRVs)	United Kingdom	Amounts of nutrients required on an average daily basis for adequate physiological function and prevention of deficiency disease (measured as EARs, RDI, AI or UL) or chronic disease prevention. NRVs are expressed on a per-day basis, but should apply to intakes assessed over a period of about 3–4 days.
Nutrient references values (NRVs)	New Zealand and Australia	
Estimated average requirement (EAR)		The medium of the requirement distribution is the daily nutrient level estimated to meet the requirements of half the healthy individuals in a particular life stage-sex group.
Recommended dietary intake (RDI)	Australia and New Zealand	The reference levels two standard deviations (SDs) above the EAR is the average daily dietary intake level that is sufficient to meet the nutrient requirements of nearly all (97.7%) healthy individuals in a particular life stage-sex group.
Recommended dietary allowance (RDA)	USA and Canada	
Reference nutritional intake (RNI)	United Kingdom	
Upper level of intake (UL)		The UL is the highest average daily nutrient intake level likely to pose no adverse health effects to almost all individuals in the general population. As intake increases above the UL, the potential risk of adverse effects increases.
Adequate intake (AI)	Australia and New Zealand	The average daily nutrient intake level, based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate. These levels were sometimes based on limited experimental or physiological data, or on <i>the specific country population's</i> median intakes for the highest consuming age group within each sex.
Safe intake	United Kingdom	
Acceptable intake	WHO/FAO	
Acceptable macronutrient distribution range (AMD)	U.S. Department of Agriculture (USDA)	The AMDR is defined as the range of intake for each macronutrient for individuals (expressed as a percentage contribution to energy), <i>that would allow for an adequate intake of all the other nutrients, while maximising general health outcome.</i>
Estimated energy requirement (EER)	U.S. Department of Agriculture National Agricultural Library	Estimated Energy Requirement (EER). The average dietary energy intake that is predicted to maintain energy balance in a healthy adult of defined age, sex, weight, height and level of physical activity, consistent with good health. $EER(kcal) = 661.8 - [9.53 \times \text{Age}(y)] + PA \times [15.91 \times \text{weight}(kg) + [539.6 \times \text{Height}(m)]]$. In children, and in pregnant and lactating women, the EER is taken to include the needs associated with the deposition of tissues or the secretion of milk at rates consistent with good health. For persons with BMI ≥ 25 , total energy expenditure is used.
Suggested dietary target (SDT)	U.S. Department of Agriculture (USDA)	Suggested dietary target: other terms used where a reasonable body of evidence of a potential chronic disease preventive effect at levels higher than EAR RDI or AI exists.

*As the evidence base for chronic disease prevention is mainly derived from studies and health outcomes in adults, acceptable macronutrient distribution range (AMD) and suggested dietary target (SDT) apply only to adults and adolescents aged 14 years and over. Country-specific variations in terminologies are identified by the shading of comparable terms.

In some cases it is not possible to ensure an adequate intake of a specific vitamin or mineral while staying within the recommended macronutrient range for carbohydrate, fat and protein intake, and therefore supplementation is required. Designing diets that conform to a given set of nutrient requirements (both minimal and maximal), while taking account of dietary energy, is complex. A number of linear modelling tools are used by individual countries. The modelling system employed in the development of the most recently published dietary guideline in Australia (2013) is consistent with the modelling process undertaken in developing the Canadian (2007) guidelines and the U.S. Department of Agriculture (USDA) (2010) guidelines. The model takes account of the amount of each nutrient in each food, the portion size, the number of portions, the range of foods that provide the nutrient, and local preferences. In the Australian guidelines, the sustainability of the production process is also taken into account.

Physical activity

The scientific evidence available on recommended physical activity levels scales for three age groups (5–17 years old; 18–64 years old; and 65 years and over) to reduce the likelihood of the occurrence of cancer, cardiorespiratory, metabolic, musculoskeletal and functional health are reported as follows:

Recommended levels of physical activity for health

Children and young people aged 5–17 years

For children and young people in the 5–17 years age group, physical activity includes play, games, sports, transportation, recreation, physical education or planned exercise, in the context of family, school, and community activities. In order to improve cardiorespiratory and muscular fitness, bone health, cardiovascular and metabolic health biomarkers, as well as reduced symptoms of anxiety and depression, the following are recommended:

1. Children and young people aged 5–17 years should accumulate at least 60 minutes of moderate to vigorous-intensity physical activity daily.
2. Physical activity of amounts greater than 60 minutes daily will provide additional health benefits.
3. Most of daily physical activity should be aerobic. Vigorous-intensity activities should be incorporated at least three times per week; these should include activities that strengthen muscle and bone.

People aged 18–64 years

For adults in the 18–64 years age group, physical activity includes recreational or leisure time physical activity, transportation (e.g., walking or cycling), occupational (i.e., work), household chores, play, games, sports or planned exercise, in the context of daily, family, and community activities. In order to improve cardiorespiratory and muscular fitness, bone health, as well as reduce the risk of non-communicable diseases and depression, the following are recommended:

1. Adults aged 18–64 years should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week, or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate-intensity and vigorous-intensity activity.
2. Aerobic activity should be performed in bouts of at least 10 minutes' duration.

3. For additional health benefits, adults should increase their moderate-intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate-intensity and vigorous-intensity activity.
4. Muscle-strengthening activities involving major muscle groups should be performed on two or more days per week.

People aged 65 years and over

For adults in the 65 years and over age group, physical activity includes recreational or leisure time physical activity, transportation (e.g., walking or cycling), work (paid or voluntary), household chores, play, games, sports or planned exercise, in the context of daily, family, and community activities. In order to improve cardiorespiratory and muscular fitness, bone and functional health, and reduce the risk of NCDs, depression and cognitive decline, the following are recommended:

1. Adults aged 65 years and over should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week, or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate-intensity and vigorous-intensity activity.
2. Aerobic activity should be performed in bouts of at least 10 minutes' duration.
3. For additional health benefits, adults aged 65 years and over should increase their moderate-intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate-intensity and vigorous-intensity activity.
4. Adults in this age group with poor mobility should perform physical activity to enhance balance and prevent falls on three or more days per week.
5. Muscle-strengthening activities involving major muscle groups should be performed on two or more days a week.
6. When adults in this age group cannot perform the recommended amounts of physical activity, due to health conditions, they should be as physically active as their abilities and conditions allow.

Overall, across all age groups, the benefits of implementing the above recommendations, and of being physically active, outweigh the harms. At the recommended level of 150 minutes per week of moderate-intensity activity, musculoskeletal injury rates appear to be uncommon. In a population-based approach, in order to decrease the risks of musculoskeletal injuries, it would be appropriate to start at a low level of physical activity with gradual progress to higher levels of physical activity.¹³

The physical activity levels vary according to a range of factors. Levels are defined for a non-pregnant, non-lactating adult, as that person's total energy expenditure (TEE) in a 24-hour period, divided by his/her basal metabolic rate (BMR): $PAL = \frac{TEE/24}{BMR}$. Physical activity levels for a range of lifestyles are presented in table 9.¹⁴

Table 9 Physical activity level for several lifestyles

Lifestyle	Example	PAL
Extremely inactive	Cerebral palsy patient	<1.40
Sedentary	Office worker getting little or no exercise	1.40–1.69
Moderately active	Construction worker or person running for one hour daily	1.70–1.99
Vigorously active	Agricultural worker (non-mechanised) or person swimming for two hours daily	2.00–2.40
Extremely active	Competitive cyclist	>2.40

Section 5: Food-based dietary guidelines

Food-based dietary guidelines (FBDGs) are simple but relevant messages on healthy eating aimed at the general public. They give an indication of what a person should be eating in terms of foods rather than nutrients, and they provide a basic framework to use when planning meals or daily menus. The WHO recommends that FBDGs portray nutrients as foods, and that they express nutritional facts in everyday language. In the European Food Safety Authority Scientific Opinion document seven steps for developing FBDGs were identified.¹⁵ Steps one to six are presented in the following pages, followed by nine key points to be considered when introducing FBDGs to the population.

Step 1a: Identification of diet-health relationships in the scientific literature (see Table 10 and Table 11).

Table 10 Examples of the relationships between exposures (dietary intake and lifestyle) and outcomes (growth) examined in determining nutritional intake requirements, by study type

Review of the evidence	
Diet (25,000 bioactive substances) + physical activity + smoking + sun exposure + other lifestyle-related factors + chance	
Exposures	Outcomes
Proximates: micronutrients Vitamins (e.g., vitamin D) Trace minerals (e.g., iron) Organic acids (e.g., lactic acid)	Measures of health [normal dietary advice] Growth (e.g.,) Skeletal childhood adolescence young adulthood older adulthood Adiposity childhood adolescence young adulthood older adulthood Neurological childhood adolescence young adulthood older adulthood
Proximates: macronutrients Carbohydrates (e.g., monosaccharides) Fats (e.g., monounsaturated) Proteins (essential amino acids)	Measure of disease [Specialised dietary advice e.g.,] infectious disease chronic disease cardiovascular disease autoimmune diseases mental health pathologies
Type of evidence reviewed Mechanistic studies: cells and animals Observational studies in populations (including cohort, case-control studies) Intervention studies among healthy persons and patients (including randomised control trial)	

Table 11 Grading of evidence (scientific reports) ¹⁶⁻¹⁸

Causal likelihood	Reduced risk		Increased risk	
	Exposure	Outcome	Exposure	Outcome
Convincing				
Probable				
Possible				
Unlikely				

Generation of specific targeted question

Is the consumption of fatty fish associated with a change in cardiovascular disease risk?

Step 1b Identification of country-specific diet-related health problems (analysis of country-specific data) (Table 12)

Table 12 Diet-health relationships pertaining to carbohydrates, fats and oils

Dietary components	Health outcome relationship direction (+/-)	Summary of diet-health relationship sourced from European Food Safety Authority
Total fat	Excessive weight gain (evidence inconclusive) +	High fat intake may contribute to excessive energy intake, energy imbalance and may promote weight gain. However, a causal relationship has not been established.
Fatty acids: saturated fats (for example, animal fats)	Risk factors for cardiovascular disease +	High saturated fatty acid (SFA) diets increase serum LDL-cholesterol. High trans fatty acid (TFA) diets increase LDL-cholesterol, reduce HDL-cholesterol and increase the total cholesterol to HDL-cholesterol ratio. These outcomes are risk factors for cardiovascular diseases. ^{19,20, 21}
Fatty acids: unsaturated fats (for example, oils)	Cardiovascular disease	High monounsaturated and polyunsaturated fatty acids (MUFA and PUFA, respectively) and long-chain omega-3 PUFA (n-3 LCPUFA) from fish and fish oils (eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)) diets may reduce the risk of cardiovascular disease. ^{19, 20, 21}
Fruit and vegetables	Obesity - coronary heart disease - stroke	Evidence from ecological and prospective studies shows that high fruit and vegetables intake is associated with a significant decrease in the risk of obesity, coronary heart disease and stroke. ^{22, 23}
Dietary fibre	Weight maintenance (~) Weight reduction in overweight subjects	An adequate dietary fibre intake is associated with weight maintenance and sustained weight reduction in overweight subjects, due to its satiating effect. Furthermore, an adequate dietary intake is associated with a reduction in cardiovascular disease. ^{19, 23, 24}
Sugars	Dental caries +	Frequent (i.e., more than about four times daily) rather than total consumption of cariogenic sugars (mainly sucrose, glucose, and fructose) is associated with dental caries in children (especially when prophylactic measures, e.g., oral hygiene and fluoride prophylaxis, are insufficient). ^{19, 25}
Energy balance (main sources of energy in food are carbohydrates and fats, with a small contribution made by proteins and, possibly, by alcohol)	Appetite regulation - energy intake + weight control +	Diets of high energy density can undermine normal appetite regulation, leading to increased overall energy intake and weight through 'passive over-consumption' of food, particularly in subjects with a sedentary lifestyle. ^{19, 23}

(~) Evidence is inconclusive

Examples provided are for illustrative purposes and are not exhaustive. Table 15 provides a more complete list of contemporary diet-health relationships that are considered to be of scientific importance to chronic disease morbidities of current concern in the field of public health.

- Step 2 Identification of nutrients of public health importance (taking account of scientific findings from previous steps)
- Step 3 Identification of foods relevant for FBDGs (statistical linear modelling of food groups)
- Step 4 Identification of food consumption patterns (statistical analysis). (Figure 15 and Figure 16 summarise aspects for consideration for FBDG points 3 to 5 presented at the end of this section)

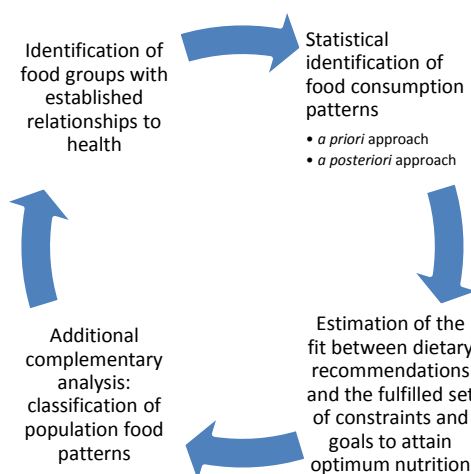


Figure 15 Key milestones in identifying relevant foods for FBDGs and food consumption patterns

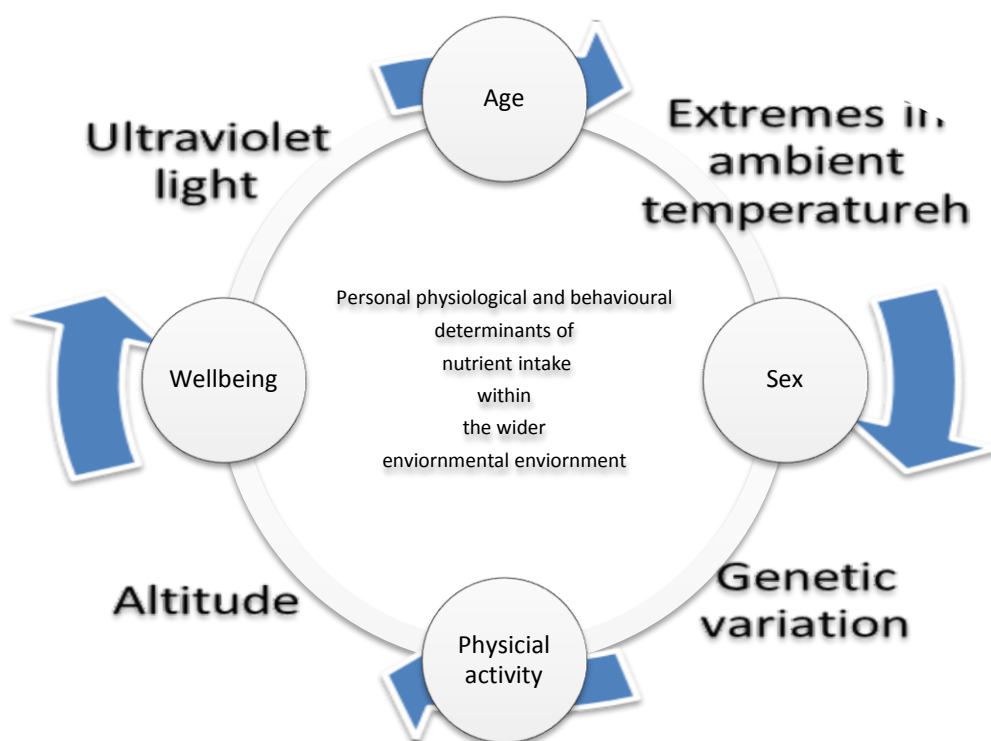


Figure 16 Personal and environmental determinants of dietary requirement

- Step 5 Testing and optimising FBDGs, and
 Step 6 Graphical representation of FBDGs (including testing) (see Figure 17 and Table 48).

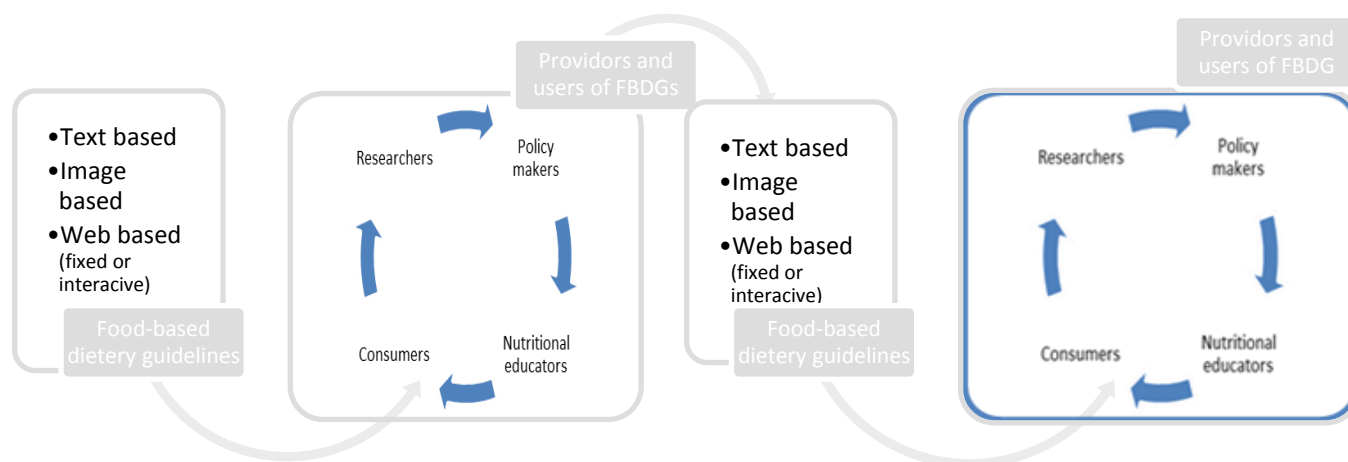


Figure 17 Food-based dietary guidelines presentation methods, providers and users

The joint FAO/WHO consultation report presents some factors to be taken into consideration when introducing FBDGs to the population.²⁶

FBDGs:

1. should be short and clear, easily remembered, and understood by the general public
2. should communicate clear and comprehensive messages, using text and visual aids
3. must be culturally acceptable with respect to dietary habits, beliefs and lifestyle
4. must encourage achievable targets, as radical changes to current habits will be less successful
5. must provide educational materials to enable professionals to deliver a clear and consistent message
6. need to be communicated via a wide selection of media
7. should target messages to relevant groups
8. should be practical to implement, i.e., the foods recommended must be available, affordable, and acceptable to the population
9. should be tested on nutritionists and consumer representatives (such as nurses, teachers, and community leaders) and, following revision, should be tested by members of the public.

Section 6: Recommended macronutrient intake range

International expert bodies have recommended macronutrient distribution ranges for carbohydrates, proteins and fats as a percentage of the dietary energy intake that is recommended by international organisations and diverse world regions, including Nordic countries, North America, Australasia and Europe. Variations in recommendations for the different macronutrients exist between regions, but a substantial overlap is also observed. For example, the lower recommended carbohydrate limit is 45% of total energy intake and the upper limit is 75%. However, recommended lower limits of 50% (Nordic countries) and 55% (WHO) and upper limits of 60% (Nordic countries) and 65% (Australia and New Zealand) are also observed. Recommendations on fibre intake range from 21 g to 40 g per day for the general population, while more specific recommendations are made for specific sex/age groups. Similarly, variations are observed for total fats; these range from 15% to 30% (WHO) or 25% to 36% (Nordic countries), sometimes with additional qualification regarding recommended value ranges for specific types of fats. These are reported in Table 13. A brief summary of the comparable differences for each macronutrient as recommended by the international expert bodies (for example, WHO/FAO), geographical regions (Nordic countries) or specific countries (for example, the USA) are presented in the final column of the table. Note: recommendations are made only for healthy individuals or those with mild metabolic conditions.

In Ireland, the current recommendations from the Department of Health, based on realistic targets, is that the calorie content of a balanced diet is obtained from protein (at 15%), fats (30–35%) and carbohydrates (55–65%). The recommended daily calorie intake for active adults in Ireland is between 1,800 calories (women) and 2,200 calories (men); the recommended calorie intake is less for sedentary adults. This is within the upper and lower limits recommended by regional and international expert bodies; these limits are 10–35% for protein, 15–36% for fats and 45–75% for carbohydrates.

Table 13 Recommended macronutrient distribution ranges for carbohydrates, proteins and fats as a percentage of dietary energy intake from international organisations and diverse world regions: Nordic countries, North America, Australasia and Europe

Macro-nutrients	1989 WHO study group recommendations	2002 Joint FAO/WHO Expert Consultation recommendations	European Food Safety Authority 2010 ¹⁵	Nordic countries ^{27, 28}	United States of America and Canada ²⁹	Australia and New Zealand ⁷	Ireland ³⁰	Comparative differences in recommended intake across world regions
Carbohydrate (% of total energy)	55–75%	55–75%	45–60%	50–60% (population goal 55)	45–65% [130 g minimum (RDA)]	45–65%	45–65%	1. Nordic countries' recommendations at the lower end of the distribution are 5% higher than the corresponding recommendations for all other countries. 2. The recommended distribution range of the Nordic countries is, at 10 percentage points, narrower than the recommended range of the European countries, at 15 percentage points, or 20 percentage points of the North American or Australasian countries.
Fibre (grams per day)	27–40 g/day	From foods	At least 25 g/day	25–35 g	19–50 years: (38 g males); 25 g (females) >50 years:	30 g (males) 25 g (females)		1. Recommended intake is 5 g lower in the Nordic countries (from upper end of the recommended range) than that

Macro-nutrients	1989 WHO study group recommendations	2002 Joint FAO/WHO Expert Consultation recommendations	European Food Safety Authority 2010 ¹⁵	Nordic countries ^{27, 28}	United States of America and Canada ²⁹	Australia and New Zealand ⁷	Ireland ³⁰	Comparative differences in recommended intake across world regions
					30 g (males); 21 g (females)			recommended in other geographical regions. 2. Recommendations are further stratified by age and sex in the North American and Australasian countries.
Sugar (percentage of total energy)	0–10% (free sugars) 50–70% (complex carbohydrate)	<10% free sugars). No recommendation for complex carbohydrate.	Not possible to set limit (free sugars). No recommendation for complex carbohydrate.	< 10% (refined sugars)	<25% (added sugar)	-		1. Recommendations on sugars (refined or added) not made by European or Australasian countries. 2. Recommended percentages of the Nordic and North American countries differ with regard to sugar intake (<10 v <25) and sugar type (refined versus added).
Total fat (percentage of total energy)	15–30%	15–30%	20–35%	25–36% (population goal 30)	20–35%	25–30%	30–35%	1. The recommended intake of total fat is consistent across all regions.
Saturated fat (percentage of total energy)	0–10%	<10%	As low as possible with nutritionally adequate diet.	<10	As low as possible with nutritionally	<8–10		1. Recommended at 10% or lower of total energy intake. 2. Recommendations on trans fats only

Macro-nutrients	1989 WHO study group recommendations	2002 Joint FAO/WHO Expert Consultation recommendations	European Food Safety Authority 2010 ¹⁵	Nordic countries ^{27, 28}	United States of America and Canada ²⁹	Australia and New Zealand ⁷	Ireland ³⁰	Comparative differences in recommended intake across world regions
			Cholesterol – no limit beside the limit set on SFA.		adequate diet			made by European countries.
Trans fat (% of total energy)		<1%	As low as possible					
Monounsaturated fat (percentage of total energy)		Make up the difference	<i>cis</i> -monounsaturated fat no DRV set (MUFA)	10–15%	-	-	-	1. Recommendations on Monounsaturated fat not made by European, Australasian or North American countries.
Polyunsaturated fat (percentage of total energy)	3–7%	6–10% 5–8% (n-6 PUFAs) 1–2% (n-3 PUFAs)	<i>cis</i> -polyunsaturated fat no DRV formulated (PFUA) linolenic acid. Adequate intake 4 E% arachidonic acid not to set a DVR, n-6 PUFA not to set an UL, n-3/n-6 ratio not to set specific values.	5–10%	-	-	-	1. Recommendations on Monounsaturated fat not made by European, Australasian or North American countries.

Macro-nutrients	1989 WHO study group recommendations	2002 Joint FAO/WHO Expert Consultation recommendations	European Food Safety Authority 2010 ¹⁵	Nordic countries ^{27, 28}	United States of America and Canada ²⁹	Australia and New Zealand ⁷	Ireland ³⁰	Comparative differences in recommended intake across world regions
			Conjugated linoleic acid: not to set a DRV Alpha-linoleic acid. AI 0.5% not to set a UL, Eicosapentaenoic acid (EPA) AL 250mg for adults, Docosahexaenoic acid adults AL 250 mg for adults					
Protein (percentage of total energy)	10–15%	10–15%		10–15% (population goal 15)	10–35%	15–25%	15%	<p>1. Among all macronutrient food groups the greatest variation in recommendations is observed in the percentage of total energy intake to be obtained from protein.</p> <p>2. The narrowest range in total energy protein intake is 5% between the lower and upper recommended</p>

Macro-nutrients	1989 WHO study group recommendations	2002 Joint FAO/WHO Expert Consultation recommendations	European Food Safety Authority 2010 ¹⁵	Nordic countries ^{2, 7, 28}	United States of America and Canada ²⁹	Australia and New Zealand ⁷	Ireland ^{3, 0}	Comparative differences in recommended intake across world regions
								<p>range as recommended by WHO/FAO and the Nordic countries. Ranges for the USA and Canada are 25%, and for Australia and New Zealand 10%.</p> <p>3. The lower end of the recommended range for the Nordic countries matches the lower range of the North American countries, while the upper end matches the lower range of the Australasia countries.</p> <p>4. The upper limit of the North American countries exceeds the upper limit of the Australasian countries by 10 percentage points, and the upper limit of the Nordic countries by 25 percentage points.</p>
Applies to specific populations:				Primarily valid for groups of	Defined as the range of	Apply to healthy populations	Apply to healthy populati	

Macro-nutrients	1989 WHO study group recommendations	2002 Joint FAO/WHO Expert Consultation recommendations	European Food Safety Authority 2010 ¹⁵	Nordic countries ^{27, 28}	United States of America and Canada ²⁹	Australia and New Zealand ⁷	Ireland ³⁰	Comparative differences in recommended intake across world regions
				healthy individuals	intake for a particular energy level and provides adequate intakes of essential nutrients and a reduced risk of chronic disease	. Not intended as reference values for the treatment of patients with diseases or conditions like diabetes, obesity, or cardiovascular disease	ons. Not intended as reference values for the treatment of patients with diseases or conditions like diabetes, obesity, or cardiovascular disease	

Chapter 5: Questions 1 and 2

Recommended number of servings, serving or portion sizes, and calorie content for carbohydrate-rich and fat-rich foods and other foods that influence carbohydrate and fat intake

Section 1: Dietary recommendations in Australia, Canada, Sweden, the United States of America and the United Kingdom

This chapter reports the most recently published national-level recommendations for servings or portions sizes of carbohydrate-rich and fat-rich foods, and fats and oils. Dietary recommendations are made by calculating the distribution of micronutrients and macronutrients across a range of food types. For all countries, the sum of each individual nutrient from a sum of all of the foods included in the dietary recommendations is the quantity needed to attain the optional intake of required micronutrients and macronutrients, as derived from the systematic review of the scientific literature. As stated earlier, the mix of macronutrients in individual foods means that choosing specific foods as proxies of specific macronutrients would be flawed. This difficulty is addressed by applying sophisticated dietary modelling techniques, such as linear programming, to quantify the contribution of specific foods to each of the micronutrient-level and macronutrient-level requirements, thus identifying the amount of each food required on a daily or weekly basis in order to achieve a nutritionally balanced diet.

The heterogeneous nature of food groups in the five countries reviewed led to the development of broad umbrella terms for four principle food groups. These comprise of some variation of four food groups containing (i) grain/cereal-based products, (ii) vegetables and fruit, (iii) milk and alternatives, and (iv) meats and alternatives. In the next section, national dietary recommendations for carbohydrate-rich foods, fat-rich foods and oil-rich foods, and fats and oils are reported for Australia (2013), Canada (2007), Sweden (2003), the United States of America (2010) and the United Kingdom (1994).

The Australian dietary guidelines are the most recently published of all dietary guidelines reviewed for this report. The Australian guidelines have built on the recent work of the United States and Canada. They have also taken into consideration recommendations from the United Kingdom, Germany and the European Union. The methods adopted by Australia in developing its guidelines are representative of the methods used by the United States and Canada. Therefore, the process in Australia is reported in detail and can also be regarded as reflecting, in spirit if not in precise detail, the process adopted by the United States and Canada. In addition to looking outwards to learn from others' experiences, Australia took account of dietary survey data collected in Australia and New Zealand that describe national-level contemporary food patterns, and anthropometric and physical activity survey data, which provide national energy requirements unique to Australasian conditions. The food pattern, anthropometric and physical activity data were also examined by all other countries under review.

While variations in international dietary recommendations exist, due to (i) differences in methodologies employed in bundling foods into food groups, (ii) temporal trends in scientific knowledge and (iii)

regional or national adaptations, the processes by which dietary intake and FBDGs are developed have been standardised by a range of international and national bodies. We have used the European Food Safety Authority seven-step process to frame the answer to the question below:

- What are the recommended number of servings, serving or portion sizes, and calorie content for carbohydrate-rich and fat-rich foods and other foods that influence carbohydrate and fat intake?

Country-specific dietary recommendations are reported under the following umbrella terms:

1. *Population characteristics* (i.e., recommended number of servings for stated age-sex-activity levels)
2. *Food groups* (country-specific) are stratified by:
 - a. food examples
 - b. food sources
 - c. standard servings
 - d. recommended servings by age-sex-activity levels
 - e. additional dietary messages pertaining to each food group, or with regard to general dietary information. These latter messages are included under each food group and/or at the end of the section.
3. Discretionary, other, extra, solid fats and added sugars (SoFAS) or leeway foods.

The information for Australia is presented in some detail, due to the contemporary nature of the recommendations and the transparency in publication of Australia's methodological approach. Information presented for Canada, Sweden, the United States of America and the United Kingdom in the main body of the text is limited to the recommended number of servings and serving sizes. More complete information for each country is presented in the tables in Appendix D.

As stated earlier, the produce and products manufactured in each of the five countries use broadly similar umbrella terms and exhibit variation in the foods bundled under or within these terms. For example, more recently, vegetables have begun to be stratified by starch content, whereas the meats and alternatives group may be stratified into two groups, meats or nuts, or kept as one group, meats and alternatives. Oils and fats are considered both as components of specific foods (because many foods contain oils and fats) and as standalone produce, or as products such as olive oil or margarine. An additional food group variously referred to as 'discretionary' or 'other foods' (Australia), solid fats and added sugars ('SoFAS') (USA) or 'leeway' (Sweden) foods, is also addressed. The approach to reporting and recommendations on these latter foods varies by country, according to the method of modelling dietary intake and the manner of providing dietary advice.

The Australian approach was to model dietary intake for the lowest energy-level requirement for each age-specific and sex-specific group. This level of intake, known as 'foundation diets', did not allow for 'discretionary' foods. However, 'total diets' which built on the 'foundation diets' by increasing energy requirements for each age-specific and sex-specific group allowed additional energy requirements to come from 'discretionary' foods. The USA and Sweden incorporated discretionary ('SoFAS' or 'leeway') foods into their dietary models, thus perhaps accepting the human appetite for more 'pleasurable' foods. However, the increase in allowed 'SoFAS' foods in the US diet were, in general, dependent on an increase in the calorie intake allowance. Canada limited dietary advice to foods from the four food groups, with individual discretion determining what, if any, other foods could be added to the diet.

Section 2: Australia

Australia – the seven-step process of developing FBDGs

Development of the new Australian dietary guidelines commenced in 1997, with plans to revise the Australian 1991 National Health and Medical Research Council (NHMRC) Recommended Dietary Intakes publication; the new Australian dietary guidelines was completed in 2013. The revision of the recommended dietary intake for the major minerals and vitamins was completed by 2001, compiled by 2004, endorsed in 2005 and published in 2006. These revised mineral and vitamin recommendations were used to develop the subsequent dietary recommendations and FBDGs.

The application of the aforementioned seven-step process by the professional bodies tasked with overseeing the development of the Australian dietary guidelines published in 2013 are summarised in Table 14. The Australian guidelines use the term 'serve' when reporting the recommended size or number of servings, to align with Australia reporting norms this term has been retained in Table 14, Table 20 and Table 23.

Table 14 Empirical application of the European seven-step FBDGs: Australia

The seven-step FBDGs development framework – as applied in Australia

1. The authors identified 22 food exposures and 120 disease or health-related outcome-relationships for systematic peer review, in order to determine the optimum nutrition range for the population. (These are listed in more detail in Table 15.)
2. The diet-related health issues identified as public health concerns above were used to determine optimum dietary intake.
3. The micronutrients identified as being of public health importance were thiamine, vitamins A and C, folic acid, calcium, iodine, iron, magnesium, zinc and linoleic acid. Diets were modelled to provide as close to 100% of the RDIs of these 10 key micronutrients as possible. These are reported on in more detail in 'Nutrient reference values for Australia and New Zealand including recommended dietary intakes (2006)'.⁷
4. Food groups used in the statistical modelling of the dietary patterns comprised core food groups identified for the 1994 exercise and composite food groups identified for the 2013 update. It is possible to identify the impact of changes in the practical modelling of diets and in scientific knowledge by comparing foods bundled in the 1994 review and in the later 2013 review. For example, differences between dairy product type and content, takes account of both the actual products themselves and their individual fat content in the modelling process.

The Core Food Groups (1994) are:

- i. Milk, yogurt, cheese: For adults, reduced-fat milk only (cheese or yogurt were not included in the model). For children and adolescents, 50:50 reduced-fat milk and full cream cheese.
- ii. Lean meat, fish, poultry, eggs, legumes 75% fat-trimmed meat and 50% skinless chicken and 50% lean plus skin on chicken. (Eggs, legumes, nuts or fish were not included in the model.)
- iii. Bread, cereals, rice, pasta, noodles, 50% rice wholegrain, 50% white bread, white rice, pasta, noodles.
- iv. Fats: an allowance of one or two teaspoons of polyunsaturated margarine per serve for 60% of the bread, cereals, rice, pasta, and noodle serves. This would equate to 15–30 g/day for six servings of cereal or 23–45 g/day for nine servings.)
- v. Extra foods – not modelled for adults: For children, one extra food based on additional 0.5 serves of oil, 0.25 serves ice cream, 0.25 serves cake (to take account of higher fat recommendations for children)
- vi. Fruit: types not specified
- vii. Vegetables and legumes: types not specified

The Composite Food Groups (2011) are:

- i. Wholegrain or higher-fibre cereals/grains: breads (wholegrain), breakfast cereal, muesli, crumpet/muff, pasta (wholegrain), rice (brown), crisp bread, porridge, oats
- ii. Refined or lower-fibre cereals/grains and breads, breakfast cereals (refined), crumpet (refined), pasta (refined), rice (white), noodles, other refined grains, crisp bread
- iii. Poultry, fish, seafood, eggs, legumes, red meats, beef, veal, lamb, kangaroo, pork
- iv. Dairy foods
 - a. Higher-fat dairy foods: milk, regular sheep-cheeses
 - b. Medium-fat dairy foods: regular milk, regular evaporated milk

National food consumption patterns and nutrition, and physical activity survey databases

- i. The Australian National Children's Nutrition and Physical Activity Survey (2007) 2–16 years.

The seven-step FBDGs development framework – as applied in Australia

- ii. The Food Standards National Food Database (2007)
- iii. The National Nutrition Survey (1995) on people over 16 years of age
- 6. The statistical methodology identified to develop and test optimum dietary patterns was the linear programming described in Chapter 4, Section 4: diet design. In Australia, the model takes account of the amount of each nutrient in each food, the portion size, the number of portions, the range of foods that provide the nutrient and local preferences. The Australian model also takes account of the sustainability of the food production process and, while it is not part of the remit of this review, the sustainability of food production processes represents a very interesting and important aspect of food consumption, cultural practices and environmental sustainability.
- 7. The image featured in Figure 18 was developed to convey dietary advice. The supporting documentation was a plate divided into portions, clearly displaying different foods and food groups, and advocating the intake of water, engaging in physical exercise, as well as limiting the intake of discretionary foods.



Figure 18 Australian Guide to Healthy Eating

Table 15 Diet-health relationship examined for FBDGs: Australia

	Relationships examined
Diet-health relationship	<ol style="list-style-type: none"> 1. <u>Fruit</u>* and CHD†, CVA, obesity, NIDDM, CA (breast, lung, colorectal, oesophageal, oral and nasopharyngeal, ovarian, endometrial, pancreatic) 2. <u>Vegetables</u> and CHD, obesity, NIDDM, CVA, CA (gastric, breast, lung, colorectal, oesophageal, oral and nasopharyngeal, ovarian, endometrial) 3. <u>Tomatoes</u> and prostate CA 4. <u>Cruciferous vegetables</u> and lung CA 5. <u>Vegetable by subtype</u> and colorectal CA 6. <u>Fruit and vegetables</u> and CHD, CVA, NIDDM, CA (colorectal, lung, ovarian) 7. <u>Meat</u> and CA (bladder, pancreatic, prostate, breast, lung, renal, colorectal) 8. <u>Dairy</u> and bone health, hip fracture, heart disease, CVA, hypertension, NIDDM, metabolic syndrome, obesity, child BMI, CA (colorectal, rectal, renal, prostate, breast, endometrial) 9. <u>Cereals</u> and colorectal CA, CVD, obesity, NIDDM 10. <u>Legumes</u> and CA (breast, prostate, colorectal), hypercholesterolaemia 11. <u>Nuts and seeds</u> and obesity, CVD 12. <u>Fish</u> and CVD, dementia, depression, age-related macular degeneration, stroke, CA (breast, colorectal, prostate, renal) 13. <u>Poultry</u> and CA (breast, colorectal) 14. <u>Eggs</u> and CHD 15. <u>Fats and oils</u> and CVD, obesity, NIDDM, hypertension, all cause CA incidence and mortality, CA (breast, endometrial), mental health 16. <u>Sodium</u> and BP, bone health, CVD 17. <u>Sugars</u> and CA, dental disease, obesity 18. <u>Sugar-sweetened beverages</u> (SSBs) and obesity, bone health, dental health 19. <u>Fruit juice</u> and overweight and obesity 20. <u>Coffee</u> and CA (gastric, hepatocellular, breast, endometrial, colorectal, bladder, ovarian, lung) CVD, hypertension, NIDDM 21. <u>Tea</u> and cancer (breast, gastric, ovarian, colorectal, lung), CVA, CVD 22. <u>Alcohol</u> and CVD, NIDDM, mental health, CA (breast, colorectal, oesophageal, of the oral cavity, pharynx and/or larynx, renal, liver, pancreatic, ovarian) non-Hodgkin's lymphoma³¹

* Underlined text denotes the food type involved in the diet health relationships examined.

†BP (blood pressure), BMI (body mass index), CA (cancer), CHD (coronary heart disease), CVA (Cardiovascular accident, stroke), CVD (cardiovascular disease), NIDDM (non-insulin dependent diabetes mellitus) (Type 2 diabetes)

‡The presentation of the diet health relationships has one exposure (food) with one or more outcomes (diseases)

Australian population characteristics

The reported recommendations for baseline diets for the youngest children in each of the specified age ranges (4–8 years, 9–11 years, 12–13 years, 14–18 years) and for adults with a very sedentary lifestyle (physical activity level 1.4) and for adult males (height: 160 cm) and females (height: 150 cm). These diets are known as 'foundation diets'. Foundation diets form the basis of all subsequent diet models that were developed to provide higher energy diets. These higher energy diets, known as 'total diets', are discussed at the end of this section.

Australian food groups

Grains (cereal) products

- a) **Food examples:** The grains (cereal) groups included in the Australia dietary models comprise: bread, breakfast cereal, rice, pasta, noodles, polenta, couscous, bulgur, oats, quinoa and barley.
- b) **Food sources:** These foods are made from grains such as wheat, oats, rice, rye, barley, millet, quinoa and corn.
- c) **Standard serving:** A standard serving of grains (cereal) food is (500 kJ/200 kcal) and is contained in one slice (40 g) bread, half a medium-sized (40 g) roll or flat bread, half a cup (75–120 g) cooked rice, pasta, noodles, barley, buckwheat, semolina, polenta, bulgur or quinoa, half a cup (120 g) cooked porridge, two-thirds of a cup (30 g) wheat cereal flakes, one-quarter of a cup (30 g) muesli, three (35 g) crisp breads, one (60 g) crumpet or one small (35 g) English muffin or scone with sultanas.
- d) **Recommended servings by age-sex-activity levels, or according to calorie intake requirements:** The recommended intake of grains (cereal) food for children range from four servings per day for 4–8-year-olds to seven servings per day for older adolescents. For women, the recommended intake ranges from three servings per day for those over the age of 70, to six servings per day for women aged under 50 years. For men, the recommended intake ranges from 4.5 servings per day for those over the age of 70 to six servings per day for men aged 19–70 years.
- e) **The health impact of specific foods, food groups:** The Australian dietary guidelines state that wholemeal or wholegrain varieties are preferable to refined-grain foods, as they provide more dietary fibre, vitamins and minerals. They also state that at least two-thirds of grains choices should feature wholegrain varieties. The Australian guidelines state that there is evidence that eating grains (cereal) foods, mostly wholegrain, protects against heart disease, type 2 diabetes and excessive weight gain, and may help reduce the risk of some cancers.

The minimum recommended number of servings of grain-based foods per day for very sedentary adults and the younger children in each of the specified age ranges are presented in Table 16.

Table 16 Number of daily servings of grain-based foods based on the energy needs of the youngest (children) in each age group and for adults with physical activity level 1.4; by sex.

	Grains intake	
	Males	Females
4–8 years	4	4
9–11 years	5	4
12–13 years	6	5
14–18 years	7	7
19–50 years	6	6
51–70 years	6	4
70+ years	4.5	3

Other grains (cereal) foods that have high amounts of added saturated fats, added sugars and/or salt (such as cakes, muffins, pies, pastries and biscuits) are not included in this group. These are classified under 'discretionary choices' and should be seldom eaten (as discussed later in this review).

Starchy vegetables

- a) **Food examples and sources:** The starchy vegetables included in the Australian dietary models are potato, sweet potato, sweetcorn and cassava.
- c) **Standard serving:** A standard serving of starchy vegetables is half a cup of sweetcorn, half a medium-sized potato or other starchy vegetables (sweet potato, sweetcorn or cassava). The standard servings for other vegetable types is 75 g (which yields 100–350 kJ/24–84 kcal), or half a cup of cooked green or orange vegetables (for example, broccoli, spinach, carrots or pumpkin), half a cup of cooked dried or canned beans, peas or lentils (preferably with no added salt), one cup of green leafy or raw salad vegetables, and one medium-sized tomato.
- d) **Recommended servings by age-sex-activity level, or according to calorie intake requirements:** The minimum recommended number of servings of starchy vegetables food for children ranges from 4.5 servings per day for 4–8 year-olds to 5.5 servings per day for older adolescents. For women, the recommended intake is five servings per day. For men, the recommended intake ranges from five servings per day for those over the age of 70 to 5.5 servings per day for men aged 51–70 years, and six servings per day for 19–50 year-old males. Data are presented in Table 17.

Table 17 Number of daily servings of starchy vegetables based on the energy needs of the youngest (for children) in each age group and for adults with physical activity level 1.4

	Starchy vegetables intake	
	Males	Females
4–8 years	4.5	4.5
9–11 years	5	5
12–13 years	5.5	5
14–18 years	5.5	5
19–50 years	6	5
51–70 years	5.5	5
70+ years	5	5

Fats (including oils)

- a) **Food examples:** Fats are classified in the Australian guidelines as saturated, monounsaturated or polyunsaturated fats, depending on their chemical structure. Trans fats are referred to, but these are not modelled for separately in developing recommendations on dietary intake.
- b) **Standard serving:** The standard serving size for unsaturated fats/oils/spreads is: 10 g polyunsaturated spread, 10 g monounsaturated spread, 7 g monounsaturated or polyunsaturated oil (for example, olive oil, canola oil or sunflower oil), 10 g tree nuts or peanuts or nut pastes/butters. The minimum recommended number of servings of polyunsaturated margarine (the only fat modelled for separately) per day are presented in Table 18.
- d) **Recommended servings by age-sex-activity level or according to calorie intake requirements:** The minimum recommended number of servings of polyunsaturated margarine for children is less than one serving per day for 4–8 year-olds, 1–1.5 servings per day for those aged between 9 and 13 years, and two servings per day for older adolescents. For women, the recommended intake is two servings per day. For men, the recommended intake ranges from two servings per day for those aged over 70 to four servings per day for 19–70 year-olds.
- e) **Additional dietary messages:** The current Australian guidelines state that foods containing saturated fats should be replaced with foods that contain unsaturated fats, i.e., either monounsaturated or polyunsaturated fats. They also state that all individuals should include some foods that contain unsaturated fats in their diet. Small amounts of unsaturated spreads and oils, or extra quantities of the nuts and seeds from which oils are made, may have health benefits, and can be included in the usual diet. The amount of unsaturated spreads or oils, nuts or seeds included in a person's usual dietary pattern is linked to individual energy needs.
- f) **The health impact of specific foods, food groups:** The current Australian guidelines state that saturated fats increase the risk of heart disease.

Table 18 Number of daily servings of polyunsaturated margarine based on the energy needs of the youngest (for children) in each age group and for adults with physical activity level 1.4

	Polyunsaturated margarine	
	Males	Females
4–8 years	<1	<1
9–11 years	1	1
12–13 years	1.5	1.5
14–18 years	2	2
19–50 years	4	2
51–70 years	4	2
70+ years	2	2

Lean meats

- c) **Standard serving:** The guidelines recommend that 1–3 servings of meats and alternatives (lean meat, poultry, fish, eggs, nuts and seeds, and legumes/beans) are eaten each day, with the exact number of servings depending on age. A standard serving is 65 g of cooked lean red meat (about 90–100 g raw), such as beef, lamb, veal, pork, goat or kangaroo (which yields 500–600 kJ).

- d) **Recommended servings by age-sex-activity level, or according to calorie intake requirements:** The recommendations for children range from 1.5 servings per day for 4–8 year-olds to three servings for males in the 19–50 years age bracket. The minimum recommended number of servings of lean meat is made in conjunction with recommendations for poultry, fish, eggs, tofu, nuts and seeds, and legumes/beans. These recommendations are presented in Table 19.
- e) **The health impact of specific foods, food groups:** According to the Australian guidelines, regular consumption of larger quantities of red meat may be associated with increased risk of colorectal cancer. Eating a variety of foods from the group containing lean meats and poultry, fish, eggs, nuts and seeds, and legumes/beans provides many nutrients, including protein, iron, zinc and other minerals and vitamins, particularly those in the vitamin B group. Vitamin B12 is found mainly in animal-based products.
- f) **Additional dietary messages:** Lean red meat (from grass-fed animals) contains essential fatty acids, including omega-3 long-chain polyunsaturated fatty acid (omega-3 LCPUFAs).

Table 19 Number of daily servings of lean meat and poultry, nuts and seeds, and legumes/beans, based on the energy needs of the youngest (for children) in each age group, and for adults with physical activity level 1.4

	Lean meat and poultry, fish, eggs, nuts and seeds, and legumes/beans	
	Males	Females
4–8 years	1.5	1.5
9–11 years	2.5	2.5
12–13 years	2.5	2.5
14–18 years	2.5	2.5
19–50 years	3	2.5
51–70 years	2.5	2
70+ years	2.5	2

Milk, yogurt, cheese and/or alternatives

- a) **Food examples:** The dairy products included in the Australian dietary models are milk, yogurt and cheese.
- c) **Standard serving:** A standard dairy product serving is (500–600 kJ) i.e., one cup (250 ml) fresh, UHT long-life milk, reconstituted powdered milk or buttermilk; half a cup (120 ml) evaporated milk; two slices (40 g) or 4x3x2 cm cube (40 g) hard cheese, such as cheddar; half a cup (120 g) ricotta cheese; three-quarters of a cup (200 g) yogurt; one cup (250 ml) soya, rice or other cereal-based drink with at least 100 mg of added calcium per 100 ml.
- d) **Recommended servings by age-sex-activity levels, or according to calorie intake requirements:** The minimum recommended amount of milk, yogurt, cheese and/or alternatives ranges from 1.5–2 servings per day for children up to 8 years old to 2.5–3.5 servings per day for older children and adolescents; 2.5 servings per day for younger adults. A wide range of milk products of varying fat levels are now available in Australia. Milk can be fresh, powdered, evaporated or UHT long life. There are cheeses available that have reduced levels of fat and/or salt. The guidelines recommend the use of low-fat dietary produce. The minimum recommended amount of milk, yogurt and cheese is out in Table 20.
- e) **Additional dietary messages:** Milk, yogurt and cheese are rich sources of calcium and other minerals, protein, and vitamins, including B₁₂.

- f) **The health impact of specific foods, food groups:** The Australian dietary guidelines state that consumption of milk, yogurt and cheese can protect against heart disease and stroke, can reduce the risk of high blood pressure and some cancers, may reduce the risk of Type 2 diabetes, and may contribute to stronger bones. However, choosing mostly full-fat varieties can increase the saturated fat and energy (kilojoule) content in the diet.

Table 20 Number of daily servings of milk, yogurt, cheese and/or alternatives, based on the energy needs of the youngest (for children) in each age group, and for adults with physical activity level 1.4

	Milk, yogurt, cheese and/or alternatives	
	Males	Females
4–8 years	2	1.5
9–11 years	2.5	3
12–13 years	3.5	3.5
14–18 years	3.5	3.5
19–50 years	2.5	2.5
51–70 years	2.5	4
70+ years	3.5	4

Nuts and seeds

The Australian dietary guidelines recommendations on nuts and seeds intake are made in conjunction with lean meat and poultry, fish, eggs and legumes/beans.

- c) **Standard serving:** A standard serving is 30 g nuts, (or seeds, peanut or almond butter or tahini or other nut or seed paste).
- d) **Recommended servings by age-sex-activity levels, or according to calorie intake requirements:** As presented in Table 21, the recommended number of servings for children ranges from 0.3 servings per day for 4–13 year-olds, 0.3 servings per day for 14–50 year-old females, and 0.4 servings per day for females aged 51–70 years and over. For adolescent males aged 14–18 years, the recommendation is 0.6–1 servings per day for males in the 19–50 years age group and 0.5 servings per day for males aged 51–70 years and over.
- e) **Additional dietary messages:** Whole nuts and seeds are not recommended for children aged three years or under, due to potential risk of choking. Nut butters or nut pastes can be used instead.

Table 21 Number of daily servings of nuts or seeds, based on the energy needs of the youngest (for children) in each age group, and for adults with physical activity level 1.4

	Nuts or seeds	
	Males	Females
4–8 years	0.3	0.3
9–11 years	0.3	0.3
12–13 years	0.3	0.3
14–18 years	0.6	0.3
19–50 years	1	0.3
51–70 years	0.5	0.4
70+ years	0.5	0.4

Discretionary choices

The Australian diet includes ‘discretionary choices’ foods – so called because they are not an essential or necessary part of healthy dietary patterns. Discretionary choices are foods that are high in kilojoules/kilocalories, saturated fat, added sugars and/or salt or alcohol. Discretionary choices include:

- most sweet biscuits, cakes, desserts and pastries
- processed meats and sausages
- ice cream and other ice confections
- confectionery and chocolate
- savoury pastries and pies
- commercial burgers
- commercially fried foods; potato chips, crisps and other fatty and/or salty snack foods
- cream, butter and spreads which are high in saturated fats
- sugar-sweetened soft drinks and cordials, sports and energy drinks and alcoholic drinks.

The guideline recommendations state that discretionary choices should be eaten only sometimes and in small amounts. While discretionary choices can help contribute to the overall enjoyment of eating, (often as part of social activities and family or cultural celebrations) most Australians need to eat these foods less often and in much smaller amounts; in addition, they need to greatly increase physical activity, in order to ‘burn off’ the added kilojoules from discretionary choices and thus help prevent gaining excessive weight. The guidelines note that if a person is short, small, above their healthiest weight, or not very physically active, there may be little or no room in their usual dietary pattern for any discretionary choices; at a minimum, the portion size needs to be quite small.

A serving of discretionary choices provides about 500–600 kJ (119–143 kcal), which is the equivalent of two scoops (75 g) ice cream; two slices (50–60 g) processed meats, salami or mettwurst; 1.5 thick or two thin (50–70 g) regular sausages; half snack-size packet (30 g) salty crackers or crisps; 2–3 (35 g) sweet, plain biscuits; one (40 g) doughnut; one slice (40 g) plain cake/small cake-type muffin, 5–6 (40 g) sugar confectionery/small lollies; one tablespoon (60 g) jam or honey; half a bar (25 g) chocolate; two tablespoons (40 g) cream; one tablespoon (20 g) butter; one can (375 ml) soft drink (sugar-sweetened); one-quarter (60 g) of commercial meat pie or pastie (individual size); 12 (60 g) fried hot chips; 200 ml wine (i.e., two standard drinks; note 1 glass of Australian wines usually represents 200 ml), or 60 ml spirits (two standard drinks).³²

Additional dietary intake recommendations and messages

Additional tips from the Australian dietary guidelines include:

- Eat less saturated fat.
- Eat fish and legumes/beans more often.
- Cut down on dishes with cream, buttery or creamy sauces or fatty gravy, choosing tomato-based dishes instead; replace sour cream or coconut milk with light evaporated milk or plain yogurt.
- Use reduced-fat yogurt, vinegar, lemon juice, herbs and small amounts of unsaturated oils for dressings.
- Do not deep-fry foods: instead, sauté, stir-fry, grill, bake, steam, boil, microwave, poach or barbeque.
- Use small amounts of unsaturated spreads and oils instead of butter.
- Choose bread-based takeaways (sandwiches, rolls and wraps) rather than commercially baked or fried foods like pies, sausage rolls, chips, fried chicken and battered and fried seafood.
- Order a side salad or vegetables, instead of hot chips.
- Choose vegetable toppings on pizza, rather than extra cheese, ham or salami.
- Choose packaged foods which state that they are reduced in fat or are low in fat.
- Limit consumption of foods that are high in added sugars, including jams, marmalades, confectionery, syrups and sweetened sauces and dressings, biscuits, cakes, sweet muffins, doughnuts, slices, puddings, sweet pastries, pies and crumbles, ice cream, chocolate and muesli bars.
- Limit intake of drinks high in added sugars, including sugar-sweetened soft drinks, cordials, fruit-drinks, vitamin waters, energy and sports drinks.

Modelling additional foods to progress from foundation diets to total diets

Once age-specific and sex-specific foundation diets were established (and cross-tested through the seven-day simulations) a variety of sample total diets were constructed for the varying energy needs within each age-sex group. These were achieved by adding to the foundation diets further servings of the various food groups used in composite modelling, including polyunsaturated margarine (as a representative food of the unsaturated fats and oils foods) and foods from the 'other foods' category, using the guiding principles outlined in Table 22. Total diets were reality tested by simulating 100 seven-day diets for each age-sex-activity level group. However, limits for some groups were needed, in order to ensure that the final balance of protein and the various fats and carbohydrates were within the acceptable macronutrient distribution range. Some limitations were placed on additional amounts for some groups:

1. Red and white meats were limited to 65 g each per day (total 130 g) for both foundation and total diets.
2. As calcium requirements had already resulted in fairly high recommendations for dairy foods in the foundation diets, overall dairy food intake was generally limited to the amounts in the foundation diets. Where a person's physical activity levels increases, there is some potential to choose more of the higher-fat options, but as dairy foods were a major contributor to saturated fats, and having taken environmental sustainability issues into account, increasing higher-fat dairy foods was not always optimal. In modelling, when dairy food intake rose above that in foundation diets, there was also a need to increase intakes of polyunsaturated fatty acids to

counterbalance the additional saturated fat, leading to an overall increase in fat intake.

However, it would be possible to choose additional dairy food servings instead of 'discretionary foods' if energy levels permit.

3. Allowances for 'other foods' and unsaturated fats and oils greater those in the foundation diets were limited in proportion to energy intake.

Table 22 Options and guiding principles used in modelling additional foods in order to progress from foundation diets to total diets

	Choose freely from these vegetables: fruit, grains (cereals), nuts and seeds categories in addition to the relevant foundation diets, in order to meet your energy needs. Variety is encouraged.													
	Additional serves of the milk/yogurt/cheese group, red meats group and the poultry/fish/seafood/eggs/legumes group over those in the relevant foundation diets can be included in place of some of the 'discretionary choices' allowances. (One serve of these food groups would equate to one 'discretionary choice' serve.)													
	Grains		Vegetables											
Food group	Wholegrain/higher fibre	Refined lower fibre cereals	Starchy	Green and brassica	Legumes	Others	Fruits	Orange	Dairy	Nuts and seeds	Lean red meats	Poultry, fish, seafood, eggs, legumes	Unsaturated spreads and oils	Discretionary choice
	Grams													
Serve size	=40*	=40*	75	75	75	75	150	75	=250**	30	65	80 g poultry 100 g fish 2 eggs 170 g legume	10 g margarine 7 g oils	600 kJ equivalent
	*Bread equivalent								**Milk equivalent					
Rounded kJ/serve	450	550	250	100	250	100	350	150	600	750	550	600	250	600
	Up to 7,000 kJ total limit (including foundation diet amount for unsaturated margarine or oils) of 30 g margarine or 20 g oils per day (210 g or 140 g/week) 7,100–8,500 kJ total limit (including foundation diet amount for unsaturated margarines or oils) of 40 g margarine or 30 g oils per day (280 g or 210 g/week) 8,500–1,000 kJ total limit (including foundation diet amount for unsaturated margarines or oils) of 50 g margarine or 35 g oils per day (350 g or 245 g/week) 10,000 kJ plus total limit (including foundation diet amount for unsaturated margarines and oils) of 60 g margarine or 45 g oils per day (420 g or 315 g/week)													
	Up to 7,000 kJ from none to no more than half serve/day discretionary choices (3.5/week) (300 kJ/day) 7,100–10,000 kJ from none to no more than two serves/day discretionary choices (14/week) (1,200 kJ/day) 10,100–12,500 kJ from none to no more than 2.5 serves/day discretionary choices (17.5/week) (1,500 kJ/day) 12,500 kJ plus from none to no more than three serves/day discretionary choices (21/week) (1,800 kJ/day)													

Examples of a range of total diets are presented in Table 23.

Table 23 An example of how an omnivore foundation diet can be built on to derive an omnivore total diet for varying daily energy needs, expressed as serves per week

	Serves per week (kJ)									
Kilojoule	7,500 kJ	8,000 kJ	8,500 kJ	9,000 kJ	9,500 kJ	1,0000 kJ	1,0500 kJ	1,1000 kJ	1,1500 kJ	1,2000 kJ
Calories	1,791	1,910	2,030	2,149	2,269	2,388	2,507	2,627	2,746	2,866
Wholegrain and higher-fibre cereals/grains	28	28	28	32	32	32	32	32	32	32
Refined or lower-fibre cereals/grains	14	14	14	17	17	17	17	17	17	17
Starchy vegetables (potato, sweet potato, sweetcorn, cassava)	5	5	5	5	12	12	12	12	12	12
Green vegetables/brassica	7	7	7	7	7	7	7	7	7	10
Orange vegetables	7	7	7	7	7	7	7	7	7	14
Legumes	2	2	2	2	2	2	12	12	12	12
Other vegetables	14	14	14	14	14	14	14	14	14	18
Fruit	14	14	14	14	14	14	14	24	24	24
Dairy foods ¹	17	17	17	17	17	17	17	17	17	17
Nuts/seeds	2	7	7	7	7	7	7	7	7	7
Red meats	7	7	7	7	7	7	7	7	7	
Poultry/fish/seafood/eggs/legumes	7	7	7	7	7	7	7	7	7	7
Additional categories:										
Unsaturated oils and spreads ²	14	14	14	14	21	21	21	21	21	28
Discretionary choices	0	0	6	6	6	12	12	12	18	18

Bolded numbers in the shaded boxes in Table 23 show where incremental changes have been made to the previous diet by the addition of serves of one or more food groups (e.g., in Table 23 when moving from a 7,500 kJ diet to the 8,000 kJ diet, an additional five serves per week of nuts and seeds were added to the pattern for the 7,500 kJ diet)

¹ Should be mostly low fat.

² As proxy for unsaturated oils (7 g serve) or seeds (10 g) in foundation diets and could also be replaced with monounsaturated oils and spreads (7 g/serve) seeds or nuts (10 g/serve) in total diets.

Note: A serve of cereals is approximately 500 kJ; nuts and seeds about 750 kJ; both fruit and legumes are about 350 kJ each per serve; starchy vegetables and unsaturated fats and oils, 250 kJ; orange vegetables are about 150 kJ per serve and both green vegetables/brassica and other vegetables are about 100 kJ. 'Discretionary choices' are approximately 600 kJ/serve.

Australia – Summary

The Australian dietary guidelines published in 2013 were developed over a 16-year period. They followed the seven-step FBDGs, and represented the combined contributions of over 60 experts.

The dietary recommendations reviewed 22 food exposures and 120 disease or health-related outcomes. The relevant public health micronutrients addressed were thiamine, vitamins A and C, folic acid, calcium, iodine, iron, magnesium, zinc and linoleic acid. Diets were modelled to provide as close to 100% of the RDIs of these 10 key micronutrients as feasible. The food groups identified from the previously published 1994 dietary recommendations were restructured using the latest scientific understanding of the beneficial or detrimental impact on health of specific foods and their nutritional content. The resultant food groups used in the statistical modelling process for the 2013 FBDGs were: grains (stratified by whole or refined products); vegetables (stratified by starch content); fruit, meats and alternatives (including legumes and pulse products); milk and alternatives (stratified by fat content). The Australian food consumption patterns and national activity data used to determine the acceptability and feasibility of diets to be modelled were derived from a range of relevant national surveys. Linear statistical programming was applied to identify, develop and test optimum dietary patterns. Over 100 seven-day dietary models were developed for each of the age ranges (4–8 years, 9–11 years, 12–13 years, 14–18 years, 19–50 years, 51–70 years and 70+ years), as well as for both sexes and for adults according to a range of physical activity levels (very sedentary lifestyle and physical activity levels ranging between 1.4 and 1.7) and for groups of varying heights (adult males of 160 cm and females of 150 cm).

Two basic diet types were developed: 'foundation diets' and 'total diets'. The foundation diets were designed to provide the optimum recommended dietary intake for the youngest in each of the age groups under 18 years, and for sedentary individuals in the adult groups. The total diets were designed to provide the optimum recommended dietary intake for the energy needs of each age-sex group beyond the needs provided for by foundation diets. Total diets were constructed by adding to the foundation diets further servings of the various food groups used in composite modelling. A sample series of six diets was designed for each age-sex-activity level group. Total diets were reality tested by stimulating 100 seven-day diets for each age-sex-activity level group.

The additional foods used to convert foundation diets to total diets included polyunsaturated margarine (as a representative food of the unsaturated fats and oils foods) and foods from what was named as the 'other foods or discretionary choices' category, representing foods high in fats or sugars. A set of guiding principles was proposed to assist in compiling bespoke diets. These principles included choosing freely from the vegetables, fruit, grains (cereals), and nuts and seeds categories, and considering additional servings of milk/yogurt/cheese, red meats and poultry/fish/seafood/eggs/legumes groups over those in the 'discretionary choice' category. Limits were stipulated on overall calorie intake levels, and on those for the macronutrients protein, fats and carbohydrates nested within the overall dietary requirements.

Recommended serving sizes, arising from the translation of recommended dietary intake into dietary guidelines, are reported by age-sex and activity-specific level. Examples of standard servings for the various food groups include:

- For grains: one slice (40 g) bread, half a medium-sized (40 g) roll or flat bread or half a cup (75–120 g) cooked rice, pasta, noodles
- For starchy vegetables: half a cup of sweetcorn or half a medium-sized potato

- For other vegetable types: 75 g or half a cup of cooked green or orange vegetables (for example, broccoli, carrots)
- For unsaturated fats/oils/spreads: 10 g polyunsaturated spread, 10 g monounsaturated spread, or 7 g monounsaturated or polyunsaturated oil (for example, olive oil, sunflower oil)
- For meats and alternatives: 65 g cooked (90–100 g raw) lean meats (for example, beef, lamb)
- For milk and alternatives: one cup (250 ml) fresh, long-life or reconstituted milk, half a cup (120 ml) evaporated milk, two slices (40 g) hard cheese, three-quarters of a cup (200 g) yogurt, or one cup (250 ml) soya, rice or other cereal-based drink with at least 100 mg of added calcium per 100 ml
- For nuts: 30 g (for example, seeds, peanut, almond butter).

The range of daily servings recommendations for both sexes at all activity levels for the 4–70+ years age group addressed in the guidelines were:

- 3–7 servings per day of grain-based foods
- 4.5–6 servings per day of starchy vegetables
- 1–4 servings per day of polyunsaturated margarine
- 1.5–3 servings per day of lean meat, poultry, fish, eggs, nuts and seeds, and/or legumes/beans
- 1.5–3.5 servings per day of milk, yogurt, cheese and/or alternatives
- 0.3–1 servings per day of nuts or seeds.

Recommendations were also made on a final food option, the 'discretionary choices' group, so called because they are not an essential or necessary part of healthy dietary patterns, and comprise food choices high in kilojoules/kilocalories, saturated fat, added sugars and/or salt or alcohol. While recognised as contributing to the overall enjoyment of eating, it was agreed that most Australians need to eat these foods less often and in smaller amounts, and to greatly increase physical activity in order to 'burn off' the added kilojoules from discretionary choices, and thus help prevent gaining excessive weight. People who were short, small or above their healthiest weight, or those not very physically active, were identified as having little or no room in their usual dietary pattern for any discretionary choices at all.

As a complementary educational tool, contemporary population diet-related concerns were specifically addressed through a limited number of key targeted messages. These addressed:

- excessive dietary intake of fat, sugar and alcohol
- deficiencies in vegetables and fruit intake or specific vitamins or minerals.

Excessive dietary intake messages identified 'culprit' foods, and provided examples of alternative replacement foods or cooking preparation methods as a public health information aid. For example, the guidelines recommended 'eat less saturated fat by eating fish and legumes/beans rather than meat; and grilling instead of deep-frying food'; dietary deficiencies messages advocated increased intake of fruit and vegetables, and where necessary, supplementary vitamin intake.

Diets other than omnivore diets were modelled to match the Irish Department of Health's dietary approach. However, only advice on omnivore diets has been reported on in this review.

Section 3: Canada

Canadian population characteristics

Unless otherwise stated, the reported recommended numbers of servings are for the energy needs of males and females in the specified age groups, assuming a sedentary level of activity.

Canadian food groups

Grains (cereal) products

- a) **Food examples:** The two grains (cereal) groups included in the Canadian dietary models comprise wholegrain products (specifically lower-fat wholegrains) and non-wholegrain products (specifically lower-fat non-wholegrains).
- b) **Food source:** These foods are made from grains such as amaranth, brown rice, buckwheat, bulgur, millet, pot barley, quinoa, spelt, triticale, whole oats or oatmeal, whole rye, wholegrain wheat and wild rice. In Canada, non-wholegrain breads and pasta are made partly or entirely with white flour that has been 'enriched'. The enrichment process restores some of the minerals and vitamins, such as iron and certain B vitamins, to levels that approximate those in wholegrain cereals.
- c) **Standard serving:** In Canada, a standard serving of grains products is a slice of bread (35 g), half a bagel (45 g), half a flatbread (35 g) for example, tortilla, pitta, 125 ml (half a cup) of cooked rice or pasta or 30 g cold (raw) cereal. Because the volume (ml) of cereal that is equivalent to 30 g varies depending on the type of cereal, it is recommended that people refer to the nutrition facts table on the packaging, which will state the equivalent volume for 30 g of the cereal in millilitres (ml) or cups.
- d) **Recommended servings by age-sex-activity level, or according to calorie intake requirements:** The recommended intake of grains (cereal) food for children ranges from four servings per day for 4–8 year-olds to six servings per day for older adolescents. For women, the recommended intake ranges from six servings per day for those over the age of 51, to 6–7 servings per day for women aged between 19 and 50 years. For men, the recommended intake ranges from seven servings per day for those over the age of 51 years to nine servings per day for men aged 19–50 years. The minimum recommended number servings of grain-based foods per day are presented in Table 24

Table 24 Number of servings of grain-based foods on the energy needs of the specified age and sex, assuming a sedentary level of activity

	Grain intake	
	Males	Females
4–8 years	4	4
9–11 years	6	6
12–13 years	6	6
14–18 years	7	6
19–50 years	8	6–7
51+ years	7	6

- e) **Additional dietary messages:** In Canada, some imported, white flour-based grain products, such as certain types of pasta, may not be enriched. It is possible to identify if the pasta product has been enriched by looking for the following nutrients in the ingredients list: folic acid, iron, riboflavin, niacin and thiamine. Most rice is not enriched with these nutrients. The Canadian dietary guidelines recommendations are to make at least half of the grain products consumed each day wholegrain. The guidelines recommend a range of opportunities to attain a diverse grain dietary intake. These include starting the day with a bowl of oatmeal, wholegrain cereal, or whole-wheat toast; trying whole grains used in different cultures, such as bulgur, pot barley, quinoa and wild rice; substituting brown rice in recipes that call for white rice; using whole-wheat pasta instead of regular pasta; baking with whole-wheat flour; substituting half the white flour with whole-wheat flour in cooking recipes; picking a cereal made with whole grains or bran. In addition, the Canadian guidelines recommend looking at the ingredients list rather than the colour of the food when choosing wholegrain foods; for example, some brown bread is simply white bread coloured with molasses. The first ingredient on the ingredients list should be a whole grain, such as wholegrain wheat. The Canadian guidelines also suggest ordering pizza made with a whole-wheat crust; choosing grain products that are lower in fat, sugar or salt; using the nutrition facts table on the packaging to compare ready-to-eat cereals; choosing cereals that have less sugar; buying lower-fat and lower-salt (sodium) versions of crackers; making sandwiches on wholegrain bagels, baguettes, bread, buns and tortillas instead of croissants; trading the morning cinnamon bun for an English muffin spread with nut butter; serving whole-wheat pitta bread with hummus rather than doughnuts or cookies as an after-school snack or for workplace meetings; keeping cookies, cakes, pastries and pies for special occasions. The Canadian guidelines state that it is a common misconception that grain products are full of fat, when in fact the opposite is true. Most grain products are naturally low in fat, but the manner of preparation and consumption can add extra calories and increase the total fat content. In addition, although many grain products are typically low in fat, it is still possible to further reduce fat consumption by choosing the lower-fat grain products, in addition to the lower-sugar and lower-salt options, and limiting the amount of fat added to these foods. One way of achieving this is to add only a small amount of oil or margarine, or choosing oils or spreads that are low in saturated and trans fats for cooking or baking. Additional ways of controlling the amount of fat added to grains and grain products include developing lower-fat muffin or pasta sauce recipes; spreading sandwiches with mustard rather than butter, margarine or mayonnaise; spicing up noodles and rice with fresh herbs or curry spice instead of rich, creamy sauces.

Starchy vegetables

- a) **Food examples:** The starchy vegetables examples included in the Canadian dietary model are the lower-fat potato choices (for example, boiled, not roasted) sweet potatoes, and orange vegetables, such as pumpkins and orange-coloured squash.
- c) **Standard serving:** In general, a standard serving of vegetables is one medium-sized fresh vegetables or fruit, or 125 ml (half a cup) of salad or raw green leafy vegetables; 250 ml (one cup) and 125 ml (half a cup) of cooked, green leafy vegetables; for dried fruit, the recommendation is 60 ml (quarter of a cup); for juice the recommendation is the equivalent of 125 ml (half a cup). The recommended number of servings per day is presented in Table 25.

Table 25 Recommended number of daily servings of vegetables and fruit, based on the energy needs of the specified age-sex group, assuming a sedentary level of activity

	Vegetables and fruit intake*	
	Males	Females
4–8 years	5	5
9–11 years	6	6
12–13 years	6	6
14–18 years	8	7
19–50 years	8–10	7–8
51+ years	7	7

**Information on the recommended intake of starchy vegetables only was not available*

- d) **Recommended servings by age-sex-activity levels, or according to calorie intake requirements:** The minimum recommended number of servings of vegetables and fruit for children ranges from five servings per day for 4–8 year-olds to six servings per day for 9–11 year-olds. For males in the 14–18 years age group, the recommended number of servings per day is eight; for females in the same age group it is seven. For males in the 19–50 years age group, the recommended number of servings per day is between eight and ten. For females in the 19–50 years age group, it is between seven and eight servings. For men, the recommended intake ranges from five servings per day for those over the age of 70 years to 5.5 servings per day for men in the 51–70 years age group and six servings per day for males aged 19–50 years.
- e) **The health impact of specific foods, food groups:** The guidelines state that vegetables and fruit contain important nutrients such as vitamins, minerals and fibre, and usually are low in fat and calories. According to the Canadian guidelines, a healthy diet rich in vegetables and fruit may help reduce the risk of cardiovascular disease (CVD) and some types of cancer. Nutrients provided by vegetables and fruit include carbohydrate, vitamins A and C, potassium, magnesium and some B vitamins, such as folate. The individual nutrients may explain some of the health benefits of eating vegetables and fruit. It is more likely, however, that the nutrients work together with other naturally occurring components in vegetables and fruit to provide the overall health benefit. The vegetables and fruit food group account for the largest proportion of the food guide servings in the healthy eating pattern, and includes vegetables and fruit in many forms – fresh, frozen, as juice, canned or dried.
- f) **Additional dietary messages:** The Canadian dietary guidelines are to eat at least one dark green and one orange vegetable each day; have vegetables and fruit more often than juice; choose vegetables and fruit prepared with little or no added fat, sugar or salt; eat vegetables and fruit at all meals and snacks; steam or microwave vegetables with sliced ginger or garlic; toss chopped vegetables with a small amount of olive oil and bake in the oven; cook a main dish with plenty of vegetables and a little bit of oil in a stir-fry or ratatouille; serve a platter of raw green peppers, celery sticks and broccoli, and try them with dips made from low-fat yogurt or low-fat sour cream; use fresh or dried herbs, spices, flavoured vinegars or lemon juice instead of salt to enhance the flavour of vegetables. Other dietary guidelines refer to eating out, and include choosing an apple, orange or fruit salad rather than a piece of pie or pastry at the cafeteria; asking for salad dressing on the side and using only a small amount; avoid choosing fruit products with 'sugar' or 'syrup' such as canned fruit. These canned foods can contain more calories per serving than unsweetened varieties; and substitute French fries with healthier options such as a baked potato or salad with dressing on the side.

Fats (including oils)

- a) **Food examples:** The Canadian guidelines on fats relate to fats and oils added to foods such as salad dressings, sauces, mayonnaise, margarine or stir-fried vegetables; they do not relate to the naturally occurring fats and oils in foods such as meat, fish, cheese, nuts and avocados.
- c) **Standard servings:** The recommended serving is a small amount i.e., 30–45 ml (between five and nine teaspoons) unsaturated fat each day. This includes oils used for cooking as well as salad dressings, margarine and mayonnaise. The Canadian dietary guidelines state that a diet low in saturated fat and trans fat can help reduce the risk of CVD.
- e) **Additional dietary messages:** People should consume mostly unsaturated fats (polyunsaturated and monounsaturated fats) such as vegetable oils, soft non-hydrogenated margarines and the type of fat found in nuts, seeds and fatty fish. These foods are important sources of essential fats (omega-3 and omega-6 fats) that cannot be synthesised by the body and must be obtained from the diet.

Nuts and nut products, lean meat and poultry

- a) **Food examples:** Only the lower-fat fresh meats, not higher-fat meats or processed meats, are included in the Canadian dietary modelling.
- b) **Food source:** The Canadian guidelines on nuts and nut products are made in conjunction with recommendations on consumption of lean meat, poultry, eggs, fish, legumes such as chick peas, kidney beans and lentils, poultry, shellfish and tofu. Lean or extra-lean cuts of meat include inside round roast, outside round roast, eye of round steak or roast, strip loin steak, sirloin steak, rump roast and lean and extra-lean ground (minced) meat or ground (minced) poultry meat.
- c) **Standard serving:** A serving of nuts or seeds is 60 ml (quarter of a cup).
- d) **Recommended servings by age-sex-activity level, or according to calorie intake requirements:** The minimum recommended number of servings of meats and alternatives for children is one serving per day for 4–8 year-olds and between one and two servings per day for 9–11 year-olds. For males in the 14–51+ years age group, the recommended number of servings per day is three, and for females in the same age group it is two servings.
- e) **Additional dietary messages:** The tips on consumption of nuts and nut products includes advice such as: to top a salad with nuts or seeds; make one's own homemade mix by combining a favourite cereal with a handful of unsalted nuts and sunflower seeds; add nuts to a vegetable stir-fry. Tenderloin cuts of meat can be lean if the visible fat is trimmed. Game meat such as bison, caribou, deer, elk and moose also tend to be lean. The guidelines warn about the increase in fat content if lean meat, poultry and fish are fried or served with gravy or other high-fat sauces. Instead of frying or deep-frying meats, the guidelines recommend baking, broiling, poaching or roasting them, and allowing the fat to drip off. The recommendations in the guidelines include: replacing meats with beans and legumes; selecting lean meats and alternatives prepared with little or no added fat or salt; minimising the amount of saturated fat in the diet by opting for lean cuts of meat and skinless poultry. The 'tips' on consumption of lean meats and alternatives include: tenderising lean cuts by marinating or slow cooking; removing or trimming as much visible fat as possible; draining fat from cooked meat; using herbs and fresh salsas to season and flavour meats; replacing half the meat with double the quantity of beans or other legumes; making sandwiches with lower-fat, unprocessed meats (roast beef, pork, lamb, turkey or chicken) and limiting consumption of higher-sodium deli and

luncheon meats (corned beef, bacon, ham, hot dogs, pepperoni, salami and smoked meat) (see Table 26)).

Table 26 Number of servings of meats and alternatives, based on the energy needs of the specified age-sex group, assuming a sedentary level of activity

	Meats and alternatives	
	Males	Females
4–8 years	1	1
9–11 years	1–2	1–2
12–13 years	1–2	1–2
14–18 years	3	2
19–50 years	3	2
51+ years	3	2

Milk and alternatives

- a) **Food examples:** In Canada, milk and alternatives are considered to be a separate food group.
- b) **Standard serving:** A standard serving of milk or alternative produce is: one cup (250 ml) of either milk, fortified soya beverage or reconstituted powdered milk. For canned (evaporated) milk, 125 ml (half a cup) is considered a serving. A standard serving also includes 175 g (three-quarters of cup) of yogurt or kefir (another type of cultured milk product) and 50 g (1.5 oz.) of cheese. The milk and alternatives food group includes milk, fortified soya beverage, canned (evaporated) milk, powdered milk, cheese and yogurt (see Table 27).
- c) **Recommended servings by age-sex-activity level, or according to calorie intake requirements:** The minimum recommended number of servings of milk and alternatives for children is two servings per day for 4–8 year-olds, between three and four servings per day for 9–18 year-olds, two servings per day for 19–50 year-olds and three servings per day for people in the 50 years+ age group.
- e) **Additional dietary messages:** The Canadian dietary guidelines are to drink low-fat milk (skimmed, 1% or 2% fat.) each day. They also state that, as the fat content of other milk products varies widely, selecting lower-fat milk alternatives is therefore preferable. Milk products with a high milk fat content (percentage milk fat), such as cheese and some yogurt, provide high amounts of fat, saturated fat and calories. Lower-fat yogurt, with 2% milk fat or less, and lower-fat cheese, with 15% to 20% milk fat or less, can help to reduce calories and saturated fat intake, but even lower-fat cheeses still contain a significant amount of saturated fat.

Table 27 Number of servings of milk and alternatives, based on the energy needs of the specified age-sex group, assuming a sedentary level of activity

	Milk and alternatives	
	Males	Females
4–8 years	2	2
9–11 years	3–4	3–4
12–13 years	3–4	3–4
14–18 years	3–4	3–4
19–50 years	2	2
51+ years	3	3

Additional dietary intake recommendations and messages

The dietary implications of foods outside the four food groups are also addressed in the Canadian guidelines. These foods are grouped into five categories, four of which are relevant here. These categories are:

1. Fats, both saturated fats (butter, shortening, cream cheese, stick margarine, whipping cream, etc.) and unsaturated fats (tub margarine, vegetable oil, salad dressing, mayonnaise, etc.)
2. Confectioneries and sugars (sugar, frozen desserts, pies, candies, chocolate-coated granola bars, Danish pastries, etc.)
3. Non-alcoholic beverages (including higher-calorie drinks such as carbonated beverages, fruit drinks, hot chocolate made with water, etc.) and lower-calorie drinks (such as coffee, tea, artificially sweetened drinks, etc.)
4. Salty snack foods, such as a potato chips, tortilla chips, popcorn, pretzels and alcoholic beverages.

The Canadian guidelines recommend that people should limit the above-mentioned foods and beverages, as they are high in calories, fat, sugar or salt (sodium). Where these foods are grain based, they are typically low in fibre and are not usually made with whole grains.^{33, 34}

Canada – Summary

Serving sizes resulting from the translation of recommended dietary guidelines are reported by age and sex and for sedentary lifestyles (Figure 19). Examples of standard servings for the various food groups include:

- For grains: one slice of bread (35 g), half a bagel (45 g), 125 ml (half a cup) of cooked rice or pasta or 30 g cold (raw) cereal
- For vegetables: one medium-sized fresh vegetable or fruit or 125 ml (half a cup), 250 ml (one cup) of salad or raw green leafy vegetables, 125 ml (half a cup) of cooked green leafy vegetables, 60 ml (quarter of a cup) dried fruit
- For fats: a small amount 30–45 ml (between five and nine teaspoons) unsaturated fat each day. This includes oils used for cooking, salad dressings and margarine.
- For nuts or seeds: 60 ml (quarter of a cup)
- For milk and alternatives: one cup of milk or fortified soya beverage (250 ml), 175 g (three-quarters of a cup) of yogurt and 50 g (1.5 oz.) cheese.

The range of daily servings recommendations for both sexes with a sedentary lifestyle for 4–51+ years addressed in the guidelines is:

- Between four and eight servings per day of grain-based foods
- Between five and ten servings per day of vegetables and fruit
- A small amount i.e., 30–45 ml (between five and nine teaspoons) unsaturated fat each day. This includes oils used for cooking, salad dressings, margarine and mayonnaise.
- Between one and three servings per day of nuts and nut products, lean meat and poultry
- Between two and four servings per day of milk, yogurt, cheese and/or alternatives.

The recommendations on foods outside the four identified food groups are to limit the intake of fats, confectioneries and sugars, non-alcoholic beverages and salty snack foods, as they are high in calories, fat, sugar or salt (sodium).

The key targeted messages include, but are not limited to recommendations to make at least half of grains products each day whole grain; attain a diverse grain dietary intake; use low-fat milk products; trim meat; eat at least one dark green vegetable and one orange vegetable each day; consume vegetables and fruit more often than vegetable/fruit juice; choose vegetables and fruit prepared with little or no added fat, sugar or salt. They also include advice to eat vegetables and fruit at all meals and snacks; steam or microwave vegetables with sliced ginger or garlic; toss chopped vegetables with a small amount of olive oil and bake in the oven; cook main dishes with lots of vegetables; use little oil in stir-fries or ratatouille; use low-fat yogurt or low-fat sour cream; use fresh or dried herbs, spices, flavoured vinegars or lemon juice instead of salt to enhance the flavour of vegetables. In specific instances, supplementary nutrient intake is advised. For example, the food-based dietary recommendation for adult males over 50 years does not reach the threshold for Vitamin D requirements. Men aged 50 or over are advised to supplement their intake of Vitamin D with pharmacological preparations.

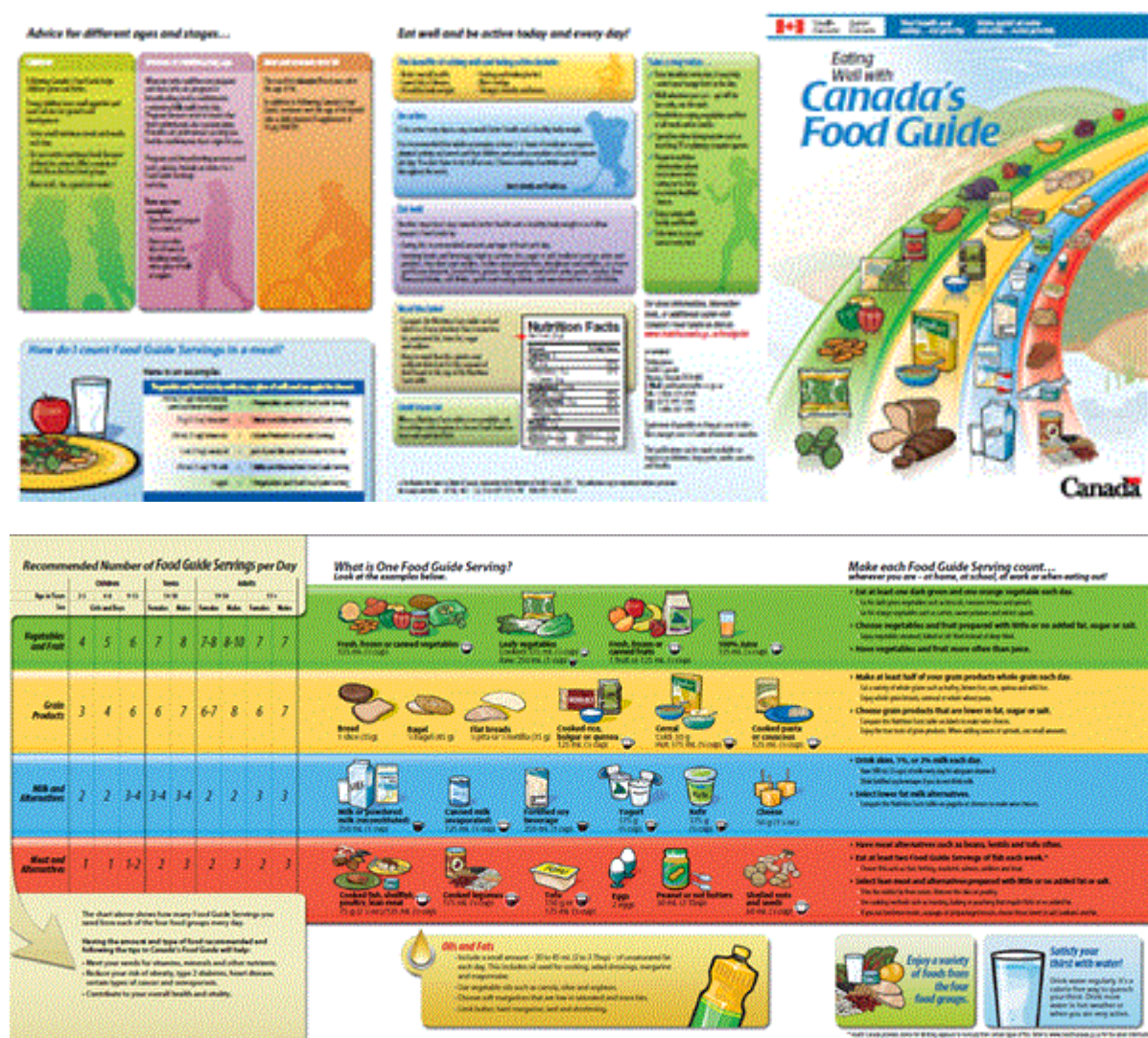


Figure 19 Canada's food guide – 2007

Section 4: Sweden

Swedish population characteristics

The Swedish recommended numbers of servings are for the energy needs of men and women aged 19–60 years with a sedentary lifestyle and who take little, or limited, physical activity in their leisure time (physical activity level 1.6). Some discretionary or leeway foods are included in the calculations for the main food groups; for example, sausage meat and pâté are leeway foods in Australia and a meat-based food in Sweden. Confectionery is a leeway food and is not included in the grains or starchy food groups.

Swedish food groups

Grains (cereal) products

- a) **Food examples:** There are two groups of bread used in the calculations. The first group comprises bread with a fibre content of 6 g per 100 g. This is regarded as fibre-rich bread and includes crisp bread and wholemeal rye bread. The second group comprises bread with lower fibre content (i.e. less than 6 g per 100 g). This group includes white bread and refined rye bread.
- b) **Food source:** The grains (cereal) products group comprises wholemeal bread, white refined rye, flour and breakfast cereal – specifically porridge, rice, couscous and pasta.
- c) **Standard serving:** In Sweden, a standard serving of grains (cereal) food is one slice (25 g) white bread, one slice (30 g) refined rye bread, one slice (15 g) crisp bread, or 40 g porridge.
- d) **Recommended servings by age-sex-activity level, or according to calorie intake requirements:** For males, the recommended number of servings of grains is eight slices of bread per day, five servings of breakfast cereal or porridge per week, and four servings of rice and pasta per week. For females, the recommended number of servings for females is the same, with the exception of the daily number of slices of bread per day, which is six. The daily recommended numbers of servings of grains (cereal) products are presented in Table 28.
- e) **Additional dietary messages:** The dietary recommendations state that about half the bread consumed should be wholemeal/Keyhole-labelled¹ if the fibre recommendation is to be fulfilled.

Table 28 Recommended grains (cereal) intake, Sweden

	Daily or weekly (as specified) cumulative grain intake in grams	
19–60 years	Males	Females
Bread	Eight (25–30 g) slices per day	Six (25–30 g) slices per day
Breakfast cereal or porridge*	40 g five times per week	40 g five times per week
Rice and pasta	Four times per week	Four times per week

*The recommend breakfast cereal can be replaced with wholemeal bread.

¹ Keyhole-labelled – Swedish symbol indicating low-fat and/or high-fibre product

Starchy vegetables

- d) **Recommended servings by age-sex-activity level, or according to calorie intake requirements:** The recommended number of daily servings of starchy vegetables is presented in Table 29. The daily recommended number of servings is one serving (219 g) per day for males and one serving (175 g) per day for females.

Table 29 Recommended servings of starchy vegetable for males and females aged 19–60 years with a sedentary lifestyle, Sweden

	Daily total starchy vegetables intake in grams	
	Males	Females
19–60 years	One serving (210 g) per day	One serving (175 g) per day

Fats (and oils) (Table 30)

- a) **Food examples:** The Swedish recommendations classify fats as saturated fat and polyunsaturated fats. The recommended intake of saturated fat was at most 10% of total recommended energy intake and the recommended intake of polyunsaturated fat is between 5% and 10% of energy intake. Furthermore, of the polyunsaturated fats, the equivalent of 1% energy intake should be n-3 fatty acids. The type of fat eaten is strongly emphasised in the Swedish dietary recommendations.
- c) **Standard serving:** In Sweden, the recommended standard serving size of fats and oils is different for males and females. The recommendations state that keeping the amount of saturated fat low (without the total amount of fat also becoming too low) is difficult given Swedish dietary habits; moreover, the choice of spread used is critical in determining whether the recommended intake is being achieved, or not. Soft margarine blends, preferably low-fat margarine and oil or liquid margarine are needed to offset the saturated fats that originate from milk, cheese, meat and cured meat products. For females, to achieve the recommended intake of fats, six slices of bread (25–30 g) per day should have margarine (two slices of bread with low-fat margarine and two slices with 80% fat margarine) and one slice should have a meat-based spread, e.g., liver pâté. For males, two slices of bread without margarine are allowed.
- d) **Recommended servings by age-sex-activity level or according to calorie intake requirements:** In Sweden, for females, a standard serving of total fat is 8 g liquid margarine, 5 g oil, 8 g cooking margarine (80% fat), 5 g margarine spread (80% fat), 5 g low-fat margarine. For males, it is 9.5 g liquid margarine, 6 g oil, 10 g cooking margarine (80% fat), 5 g margarine spread (80% fat), 20 g low-fat margarine.
- e) **Additional dietary messages:** For both males and females, margarine and oil for spreading, cooking and salad dressings contribute around 38% of fat. Approximately 40% of margarine and oil is intended for spreading, and the rest is used for cooking and salad dressings. One slice of bread is assumed to use 5 g of margarine and oil. If a spread with 60% fat is chosen, it means that females are allowed between three and four slices of bread with spread per day, and males are allowed five slices of bread with spread per day. This means that one of the recommended slices of bread should be consumed without spread or other topping every day, e.g., eaten with food. Sandwiches with a spreadable filling such as liver pâté or whey cheese are assumed to not include margarine. Spread fat can be varied in a number of ways with respect to the type of product. The important factor is to keep the total amount of fat originating from spread constant and to choose a margarine that includes a high content of unsaturated fatty acids. There is, therefore, no provision in the Swedish dietary

recommendations for consumption of butter on bread. Fat for cooking is mainly 'liquid margarine' or oil. Solid margarine is only used for baking. The recommendations state that it is difficult to make provision for butter, due to its high content of saturated fat, but it can replace solid cooking margarine. The average Swedish diet involves consumption of a higher percentage of fat than that recommended by international bodies, but the desire to make the recommended diet acceptable to the Swedish population means that advocating a severe reduction in fat content is not possible at present.

Table 30 Weekly (cumulative weekly total) recommended added fats and oils intake for males and females aged 19–60 years with a sedentary lifestyle, Sweden

	Weekly cumulative total fat intake in grams, by recommended frequency and serving size	
19–60 years	Females	Males
Liquid margarine	7 x 8 g	7 x 9.5 g
Oils	10 x 5 g	10 x 6 g
Cooking margarine (fat 80%)	3 x 8 g	3 x 10 g
Margarine spread (fat 80%)	11 x 5 g	15 x 5 g
Low-fat margarine (fat 40%)	15 x 5 g	20 x 5 g

Meat and cured meat products

- a) **Food examples:** Meat (including all luncheon meats except sausage and liver pâté) are divided into two groups – lean meats and fatty meats. The fatty meats group has an average fat content of 15% and the lean meats group has an average fat content of 5%. The lean meats group includes all meats with a fat content of 10% or less.
- d) **Recommended servings by age-sex-activity level, or according to calorie intake requirements:** The recommendations include between six and seven portions of meat per week, including sandwich meats. The total recommended numbers of servings for males and females are reported in Table 31.
- e) **Additional dietary messages:** It is recommended that in order to ensure that intake of saturated fat and total fat is not exceeded, 50% of all meat consumption should be derived from the lean meats group (i.e., a fat content of 10% or less). In total, meat and cured meat products contribute one-quarter of saturated fat to the recommended diet.

Table 31 Weekly (cumulative weekly total) recommended meat and cured meat products intake for males and females aged 19–60 years with a sedentary lifestyle, Sweden

	Daily, weekly or monthly (as specified) meat and cured meat products intake in grams	
19–60 years	Females	Males
Lean meats (fat < 10%)	Three times per week (95 g*)	Three times per week (120 g*)
Fatty meats	Four times per week (95 g*)	Four times per week (120 g*)
Sausage	Once per week (100 g*)	Once per week (125 g*)
Black pudding	Once per month (150 g*)	Once per month (225 g*)
Liver pâté	Seven times per week (15 g*)	Seven times per week (15 g*)
*per serving		

Milk, cheese and other dairy products

- a) **Food examples:** The milk, cheese and other dairy products included in the Swedish dietary recommendations are low-fat milk and cheese (17% fat or less), a small portion of Keyhole-labelled cheese, a small amount of soft cheese and cooking cream (15% fat). The cream included in the food list is cooking cream (15% fat) and equivalent products with a low-fat content. Whipping cream is only included in cakes; in other words, it is a leeway food. (Cooking cream can be exchanged for half whipping cream, half milk.)
- b) **Standard serving:** Standard servings of dairy products vary, but in calculating intake recommendations, certain assumptions are made. These include the assumption that 10–15 g cheese is equivalent to 100 ml milk, and that low-fat milk and cheese (17% fat or less) are chosen on most occasions.
- d) **Recommended servings by age-sex-activity level, or according to calorie intake requirements:** For males, the recommended number of servings is 11 glasses/750 ml milk per week and 20 g cheese per day. For females, the recommended number of servings is 13 glasses/950 ml milk per week and 20 g cheese per day. The total recommended number of servings of dairy products for males and females is reported in Table 32.
- e) **Additional dietary messages:** The amount of cheese (approximately 20 g per day) is the maximum possible, and is the equivalent of a cheese sandwich every day. Larger amounts of cheese affect energy distribution, particularly with respect to protein and saturated fat, and mean that consumption of other foodstuffs, such as meat, has to be limited. The amount of cheese is maximised in order to minimise the difference between the 1997-98 consumption (28 g per day for females and 31 g per day for males).

Table 32 Recommended (cumulative weekly total) added milk, cheese and other dairy product intake for males and females aged 19–60 years with a sedentary lifestyle, Sweden

Milk and yogurt	Daily and weekly total milk and yogurt intake in mls	
	Females	Males
With tea/coffee	40 ml per week	40 ml per week
Warm with coffee	150 ml per week	150 ml per week
Milk as a drink	200 ml per week	200 ml per week
Milk with porridge/cereal	200 ml per week	250 ml per week
Yogurt	200 ml per week	250 ml per week
Milk and yogurt total	11 glasses per week	13 glasses per week
Cheese	20 g per day	20 g per day
Cream	Not specified	Not specified

Leeway foods

The foods identified as components of the leeway foods category encompass savoury snacks, pastries, cakes, ice cream, jam, fizzy drinks, sweets and alcoholic drinks. A total of 13–14% (i.e., 1.2 to 1.6 MJ/287 to 382 kcal) of energy intake from this category is allowable in the Swedish dietary recommendations. More sweet foods than fatty foods are included within the leeway foods allowance, so as not to affect the energy balance. One of the starting points for the Swedish dietary recommendations intake was that the food list should also include nutritionally less desirable foods. One important principle is that there should be scope for all kinds of foods, even those that are

normally considered unhealthy. Leeway foods contribute 9% of fat and 14% of saturated fat in the recommended Swedish diet. However, leeway foods may not simply be added without limit. In determining limits, the main deciding factor is the amount of alcohol, sugar and saturated fat in the leeway food, which to a large extent affects energy distribution in each leeway food. This means that within the scope of dietary allowances, sweet foods should be chosen in preference to fatty foods. The foods included in the leeway framework may be replaced with other foods, e.g., cheese instead of chocolate, juice instead of fizzy drinks, but as leeway foods affect energy distribution, the consumption choices made must still be in favour of carbohydrate-rich foodstuffs. Alcoholic drinks are also included in the leeway group; these are converted to pure alcohol in Table 33, in order to make the amounts comparable. Alcohol contributes 1–2% of total energy in the recommended diet. An expanded list of options for leeway foods are shown in Table 33. The majority of these options are sweet foods.

Table 33 Recommended (cumulative weekly total) leeway foods intake for males and females aged 19–60 years with a sedentary lifestyle, Sweden

	Weekly cumulative leeway foods intake in grams	
	Females	Males
Savoury snacks	7 g	7 g
Buns, pastries, cakes	95 g	150 g
Ice cream	50 g	50 g
Desserts	70 g	88 g
Sweets	123 g	140 g
Jam	165 g	195 g
Fizzy drinks	231 g	231 g
Sugar	15 g	20 g
Alcohol*	4 g	8 g

*Pure alcohol

Additional dietary intake recommendations and messages

The Swedish Food Administration's reference group for collaboration on healthy dietary habits expressed a request for a small number (i.e., between three and five) general messages that could be used by different actors in conveying the dietary messages regarded as most important for improving the health of the population. The messages agreed were:

- Consumption of fruit and vegetables is too low and should be increased, as should consumption of bread.
- Improving the quality of the fats consumed is just as important as reducing total fat intake.
- Consumption of the so-called leeway foods should be decreased.

In addition, the maximum level of alcohol consumption was set at 2% energy. The recommended meal pattern involves dividing daily energy intake so that breakfast provides 20–25% energy, lunch provides 25–35% energy, and dinner provides 25–35% energy. Two or three snacks must also be included per day.

A summary of previous dietary recommendations, based on most the recently examined scientific evidence, and found to remain true, are also reiterated. These include:

- Choose Keyhole-labelled goods in supermarkets and restaurants. (From 1989 dietary advice).

- 'For adults, an intake of milk and cheese corresponding to approximately half a litre of milk per day is appropriate... Adults should primarily choose low-fat products.' (From 1990 dietary advice)
- Eat according to the plate model. (From 1992 dietary advice)
- Choose foods with good carbohydrates and high fibre – bread (preferably wholemeal), breakfast cereals, porridge, pasta, fruit, vegetables, potatoes and root vegetables. (From 1992 dietary advice)
- National Food Administration advice on fish consumption, which states that fish is healthy and that most people should eat more fish, but with limitations for certain species, due to polychlorinated biphenyls (PCBs) and heavy metal content. (See advice on fish consumption from 1995 dietary advice)
- Choose soft fat rather than hard fat. (From 1996 dietary advice)
- Eat 0.5kg fruit and vegetables per day. (From 1999 dietary advice).³⁵

How does Ireland compare to Sweden?

The type of diet in Sweden, and its method of calculation, do not all allow us to make direct comparisons with Ireland.

Sweden – Summary

The Swedish recommended serving sizes for the energy needs of males and females aged 19–60 years, with a sedentary lifestyle, that is, little or limited physical activity in their leisure time (physical activity level 1.6). Some discretionary foods or leeway foods are included in the main food group calculations; for example, sausage meat and pâté are categorised as leeway foods in Australia, but are categorised as meat-based foods in Sweden.

The recommended numbers of servings and the sizes of these servings are reported as daily or weekly recommendations (Figure 20). In the guidelines these are:

- For grains: between six and eight servings of a 25–30 g slice of bread per day, five servings of 40 g cereal or porridge per week, and rice or pasta (amounts not specified) four times per week.
- For starchy vegetables: 175–210 g per day.
- For fats: cumulatively per week, 56–66.5 g liquid margarine; 50–60 g oil; 34–40 g of 80% fat cooking margarine; 55–75 g of 80% fat margarine spread and 75–100 g of 40% fat margarine.
- For meat and cured meats: 285–360 g lean meat (less than 10% fat) per week; 380–480 g of fatty meats per week; 100–125 g sausage per week; 150–225 g of black pudding per month and 105 g liver pâté per week; 590–980 ml low-fat milk per week, 200 ml yogurt per week and 20 g cheese per day.

In addition, between 13% and 14% of energy intake from leeway or discretionary foods was allowed. These so called 'leeway' foods are estimated to contribute 9% of the total fat allowed, of which 14% is unsaturated fat and 86% is saturated fat, while alcohol is calculated to contribute 1% to 2% of energy intake. Examples of the recommended number of servings per week of leeway/discretionary foods, and the size of these servings, are as follows: 7 g savoury snacks; 95 g buns, pastries, cakes; 50 g ice cream; 70 g desserts; 123 g sweets; 165 g jam; 231 g fizzy drinks; 15 g sugar and 4 g alcohol.

The key targeted messages include, but are not limited to, recommendations to choose Keyhole-labelled goods; this is a labelling system that identifies low-fat and/or high-fibre products in

supermarkets and restaurants. Other recommendations include: eat according to the plate model, which provides a visual aid on optimum proportional distribution of the various food groups; choose low-fat and high fibre goods; increase fish intake; eat soft fat rather than hard fat; eat plenty of fruit and vegetables. The messages reiterate, and build on, the dietary advice from previous national-level educational programmes.



Figure 20 The Swedish food plate

Section 5: The United States of America

American population characteristics

The United States of America dietary guidelines are issued by the U.S. Department of Agriculture (USDA). Serving sizes for grains and fruit are reported as average daily intake, and for vegetables and protein-rich foods, as average weekly intake. Unlike Australia and Canada, which make recommendations for age-sex-activity level groups, the US recommendations are made according to specific daily calorie requirements. In addition, the USA use imperial, and not metric, measurements for reporting, further impeding inter-country comparisons. The daily calorie intake requirement categories range from 1,000 kcal to 3,200 kcal, with 200 kcal increments. Recommendations with a calorie intake of 1,000, 1,200, and 1,400 calories meet the nutritional needs of children aged 2–8 years. Recommendations with a calorie intake of between 1,600 and 3,200 calories meet the nutritional needs of children aged nine years and older, as well as the nutritional needs of adults of varying physical activity levels. Both children aged nine years and older and adults are advised not to follow the 1,000, 1,200, or 1,400 calorie intake recommendations.

American food groups

Grains (cereal) products

- a) **Food examples and sources:** The grains (cereal) groups included in the USDA dietary models comprise brown rice, wholegrain sorghum, buckwheat, wholegrain triticale, bulgur (cracked wheat), wholegrain barley, millet, wholegrain corn, oatmeal whole oats/oatmeal, popcorn, whole rye, quinoa, whole wheat, rolled oats or wild rice, as well as the refined grains for white bread and white rice.
- c) **Standard serving:** A standard serving of grains (cereal) food of 1oz-equivalent of grains is a single 1 oz. slice of bread; 1 oz. (28.4 g) uncooked pasta or rice; half a cup of cooked rice, pasta, or cereal; one tortilla (6" diameter); one pancake (5" diameter); 1 oz. ready-to-eat cereal (about one cup of cereal flakes). (See Table 34.)
- d) **Recommended servings by age-sex-activity level, or according to calorie intake requirements** are a daily intake of between 1.5–5 oz-equivalent, in order to achieve a 1,000–3,200 per day calorie intake of both whole grains and enriched grains.

Table 34 Recommended average daily intake of grains, based on a calorie intake requirement of 1,000, 1,600, 2,000 or 3,200 kcal per day

	1,000	1,600	2,000	3,200
Whole grains	1.5 oz-equivalent	3 oz-equivalent	3 oz-equivalent	5 oz-equivalent
Enriched grains	1.5 oz-equivalent	2 oz-equivalent	3 oz-equivalent	5 oz-equivalent

Starchy vegetables

- a) **Food examples:** The starchy vegetables included in the USDA dietary models are as follows: all fresh, frozen, and canned starchy vegetables, such as white potatoes, corn, and green peas (see Table 35).
- d) **Recommended servings by age-sex-activity level, or according to calorie intake requirements:** A weekly intake of 2–8 oz-equivalent, in order to achieve a 1,000–3,200 per day calorie intake.

Table 35 Recommended weekly amounts of starchy vegetables, based on a calorie intake requirement of 1,000, 1,600, 2,000 or 3,200 kcal per day

	1,000	1,600	2,000	3,200
Starchy vegetables	Two cups per week	Four cups per week	Five cups per week	Eight cups per week

Fats and oils

- a) **Food examples and sources:** The oils included in the USDA dietary models are oils rich in monounsaturated fatty acids (canola oil, olive oil and safflower oil). Polyunsaturated fatty acids (soyabean oils, corn oil, and cottonseed oil). Solid fats – beef fat (tallow, suet), butter, chicken fat, coconut oil, cream. Hydrogenated oils (palm kernel oil and palm oil). Partially hydrogenated oils – pork fat (lard), shortening and stick margarine. Oils and soft margarines – vegetable oil, nut oil and fish oils, and soft vegetable oil table spreads that do not contain trans fats.

- c) **Standard serving:** The fat content of a product changes the serving amount for fats and oils. For example, one tablespoon (20 ml) regular salad dressing = one serving; two tablespoons of low-fat dressing = one serving; one tablespoon of fat-free dressing = zero servings. A standard serving of oils and fats is one teaspoon of soft margarine, one teaspoon of vegetable oil, one tablespoon of mayonnaise or one tablespoon of salad dressing.
- d) **Recommended servings by age-sex-activity level, or according to calorie intake requirements:** The amount of oils eaten each day depends on age-sex-level of physical activity. The USDA does not differentiate between polyunsaturated and monounsaturated fats (oils). Women aged 31 years and over, and who exercise for 30 minutes each day, can eat five teaspoons servings of oil each day (total 25 ml). Men aged 31 years and over, and who do moderate exercise for 30 minutes each day, can eat six teaspoons of oil each day (total 30 ml). The daily allowance of oil includes the oils in fish, nuts and salad dressings, cooking oil, non-hydrogenated spread, olives and avocados.

Lean meats, poultry, and fish

- c) **Standard serving:** A standard serving of lean meats, poultry, and fish is 1 oz. (28.4 g) cooked meats, poultry, or fish or one egg. Lean meats, poultry, and fish (see Table 36) are recommended as rich sources of protein and magnesium, whereas nuts, seeds and legumes are recommended as rich sources of energy, magnesium, protein and fibre (see Table 37).
- d) **Recommended servings by age-sex-activity level, or according to calorie intake requirements:** A weekly intake of meat, poultry and eggs of 10–34 oz-equivalent, in order to achieve a 1,000–3,200 per day calorie intake.

Table 36 Recommended weekly amounts of meat, poultry or egg products, based on a calorie intake requirement of 1,000, 1,600, 2,000 or 3,200 kcal per day

	1,000	1,600	2,000	3,200
Meat, poultry, eggs	10 oz. per week	24 oz. per week	26 oz. per week	34 oz. per week

Nuts, seeds and soya products

- d) **Recommended servings by age-sex-activity levels, or according to calorie intake requirements:** A weekly intake of nuts, seed or soya products of 1–5 oz-equivalent, in order to achieve a 1,000–3,200 per day calorie intake.

Table 37 Recommended weekly amounts of nuts, seed and soya products, based on a calorie intake requirement of 1,000, 1,600, 2,000 or 3,200 kcal per day

	1,000	1,600	2,000	3,200
Nuts, seeds, soya products	1 oz. per week	4 oz. per week	4 oz. per week	5 oz. per week

Dairy: fat-free or low-fat milk and milk products

- a) **Food examples:** The milk and milk products included in the USDA dietary models consist of: fat-free milk or buttermilk; fat-free, low-fat, or reduced-fat cheese; fat-free/low-fat regular or frozen yogurt.
- c) **Standard serving:** A standard serving of fat-free or low-fat milk or milk products is one cup of milk or yogurt, or 1.5 g cheese. Cream, sour cream, and cream cheese are not included, due to their low calcium content (see Table 38).
- d) **Recommended servings by age-sex-activity level, or according to calorie intake requirements:** A daily intake of dairy products of between two and three cups, in order to achieve a 1,000–3,200 per day calorie intake.

Table 38 Recommended daily amounts of dairy products, based on a calorie intake requirement of 1,000, 2,000 or 3,200 kcal per day

	1,000	1,600	2,000	3,200
Dairy	Two cups	Three cups	Three cups	Three cups

Leeway or SoFAS (solid fats and added sugars) foods

SoFAS are calories from solid fats and added sugars. The limit for SoFAS is the remaining amount of calories in each recommended dietary allowance after selecting the specified amounts in each food group in nutrient-dense forms (forms that are fat free or low fat, and with no added sugars). The number (and percentage) of calories for each of the reported intake ranges is 137 calories (14%) for those with a daily recommended calorie intake of 1,000; 121 calories (8%) of the recommended 1,600 calorie intake; 258 calories (13%) of the recommended 2,000 calorie intake, and 296 calories (19%) of the recommended 3,200 calorie intake. Interestingly, the 2010 US Dietary Guidelines do not provide examples of SoFAS).¹⁶

Additional dietary intake recommendations and messages

The USDA advises people that ‘at least half the grains eaten should be whole grains’, in order to consume more complex carbohydrates. The amount of grains eaten depends on age-sex-level of physical activity. Females aged 19–50 years, and who exercise for 30 minutes each day, can eat six 1 oz. servings of carbohydrates (total 180 g) each day; half of these servings should be wholegrain. Males aged 19–30 years, and who do moderate exercise for 30 minutes each day, can eat eight 1 oz. servings (total 240 g) carbohydrates each day; half of these servings should be wholegrain.

The USDA advises that people substitute (saturated) fats with (unsaturated) oils. It also advises that saturated fats, trans fats, and cholesterol tend to raise ‘bad’ (low-density lipoprotein LDL) cholesterol levels in the blood, which in turn increases the risk for heart disease. To lower the risk for heart disease, it recommends cutting back on foods containing saturated fats, trans fats, and cholesterol. In the section on dairy products that contain animal fats or saturated fats, the USDA recommends that people switch to fat-free or low-fat (1%) milk, yogurt or cheese; furthermore, the recommendations state that if a person continues to use full-fat dairy products, these products count against their maximum limit for ‘empty calories’ (or calories from solid fats and refined sugars). Solid fats and added sugars add calories to the food intake, but add either few or no other nutrients. For this reason, the calories from saturated fats or animal fats and refined sugars in a food are often called ‘empty calories’.

USDA dietary advice on fats is as follows: when using spreads, choose soft margarines with zero trans fats, i.e., margarines made from liquid vegetable oil instead of stick margarine or butter. If people do use butter, they should use only a small amount. When cooking, use vegetable oils such as olive oil, canola oil, corn oil, safflower oil, or sunflower oil rather than solid fats (i.e., butter, stick margarine, shortening, lard). Consider calories when adding oils to foods or when cooking. Use only small amounts, so as to keep calories in check. Use the ingredients list, in order to choose foods that contain oils with more unsaturated fats. Use the 'Nutrition facts' label to choose foods that contain less saturated fat. When possible, replace solid fats with oils (major sources of polyunsaturated and monounsaturated fatty acids).

USDA dietary advice on meats is as follows: select only lean meat; trim away visible fats; broil, roast, or poach; remove skin from poultry. Since eggs are high in cholesterol, limit egg yolk intake to no more than four per week; two egg whites have the same protein content as 1 oz. meat.

USA – Summary

US serving sizes, resulting from the translation of recommended dietary intake into dietary guidelines, are reported by calorie intake.

Examples of serving sizes for the various food groups include:

- For grains (cereal): A single 1 oz. slice of bread; 1 oz. (28.4 g) uncooked pasta or rice; half a cup of cooked rice, pasta, or cereal; one tortilla (6" diameter); one pancake (5" diameter); 1 oz. of ready-to-eat cereal (about one cup cereal flakes).
- For servings of vegetables: one cup, (the volume of a cup occupied by different vegetables varies, therefore it is not possible to give a representative measure of mass for this food group; to account for this US guidelines specific serving sizes for various kind of vegetables).
- For fats: one teaspoon of soft margarine, one teaspoon of vegetable oil, one tablespoon of mayonnaise or one tablespoon of salad dressing.
- For meats and alternatives: 1 oz. (28.4 g) cooked meats, poultry, or fish or one egg.
- For dairy produce and alternatives: One cup of milk or yogurt, or 1.5 oz. cheese.

The recommended serving sizes for the total age range and for both sexes addressed in the guidelines are:

- a 1.5–5 oz. serving of whole grains and a 1.5–5 oz. serving of enriched grains per day
- Between two and eight cups of starchy vegetables per week
- 10–34 oz. of meat, poultry and eggs per week
- 1–5 oz. of nuts, seed and soya produce per week; between two and three cup-size servings of dairy products per day.

Recommendations regarding the number of calories (and the percentage of recommended calories) of leeway or SoFAS, range from 121 (8%) of the recommended 1,600 daily calorie intake to 296 (19%) of the recommended 3,200 daily calorie intake.

The key targeted messages are: people should ensure that at least half their grains are whole grains; substitute saturated fats with unsaturated oils; use fat-free milk; choose spreads and soft margarines made from oils rather than that stick margarine or butter; use cooking oils instead of solid fats; trim meat.

The US food plate is presented in Figure 21.



Figure 21 The US food plate

Section 6: The United Kingdom (England)

United Kingdom population characteristics

The United Kingdom (England) Department of Health does not provide dietary recommendations at the level of detail available from the countries previously cited. It does, however, provide advice using the eatwell plate. The eatwell plate is a key policy tool that defines the department's recommendations on a healthy diet. The eatwell plate provides a visual representation of the types and proportions of foods needed for a healthy, balanced diet i.e., plenty of starchy foods, fruit and vegetables, some milk, dairy, meat, fish and other non-dairy sources of protein, and only small amounts of food and drinks high in fat and/or sugar.

The eatwell plate is based on recommendations from the Committee on Medical Aspects of Food and Nutrition Policy (COMA) reports on Diet and Cardiovascular Disease (1984) and Nutritional Aspects of Cardiovascular Disease (1994). These recommendations continue to be endorsed by the Scientific Advisory Committee on Nutrition (SACN), which succeeded COMA in 2001. The plate was previously known as the Balance of Good Health and launched in 1994 by the Department of Health as the National Food Guide – the Balance of Good Health ³⁶.

The calculation of segment size was based on quantitative guidelines for the consumption of foods within each of the five food groups, in order to ensure a national average diet that is consistent with UK Dietary Reference Values (DRVs).

In 1991, the Department of Health set dietary reference values, which are benchmark intakes of energy and nutrients. These show the amount of energy or the amount of an individual nutrient that people in a certain age-sex group need for good health. The DRVs are not exact recommendations. They can be used for population-based guidance, but cannot be used for individuals. As portions and serving sizes are not available, DRVs for macronutrients, vitamins and minerals, by age and sex, are reported in Table 39.

Table 39 Dietary reference values for macronutrients, vitamins and minerals, by age group and sex

Macro-nutrients	Age groups (years)													
	1–3		4–6		7–10		11–14		15–18		19–50		51–64	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
Energy (kJ/d)	5.15	4.86	7.16	6.46	8.24	7.28	9.27	7.72	11.51	8.83	10.6	8.1	10.27	8.0
Energy (kcal/d)	1230	1165	1715	1,545	1,970	1,740	2,220	1,745	2,755	2,110	2,550	1,940	2,465	1,900
Protein (g/dg)	14.5	14.5	19.7	19.7	28.3	28.3	42.1	41.2	55.2	45	55.5	45	53.3	46.5
Fat (g/d)			66.7	60.1	76.6	67.7	86.3	71.8	107.1	82.1	99.2	75.4	95.9	73.9
Saturated fat (g/d)			21.0	18.9	24.1	21.3	27.1	22.6	33.7	25.8	31.2	23.2	30.1	23.7
Carbohydrates (g/d)			228.7	206.0	262.7	232.0	296.0	246.0	367.3	281.3	340.0	258.7	328.7	253.7
Non-milk extrinsic sugars			50.3	45.3	57.8	21.0	65.1	54.1	80.8	61.9	74.8	56.9	72.3	55.7
Fibre (g/d)	1.25	1.25	1.75	1.75	3	3	4	4	4	4	4	4	4	4

kJ/d Kilojoule daily kcal/d kilocalories daily d/g grams daily

A full list of dietary reference values can be found in the *Dietary Reference Values for Food Energy and Nutrients for the UK*, Department of Health, 1991: Report of the Panel on DRVs of the Committee on the Medical Aspects of Food Policy (COMA). In relation to particular food groups, the Department of Health recommends that people (Table 40):

- Eat at least five portions of a variety of fruit and vegetables every day; these fruit and vegetables can be fresh, frozen, dried or juiced. One portion (80 g) equates to one apple, banana, pear, orange or other similar-sized fruit; two plums or similar-sized fruit, and three heaped tablespoons of vegetables (raw, cooked, frozen or tinned). However, fruit or vegetable juice counts as one portion no matter how much is consumed per day (a portion of juice is 150 ml ideally), the remaining portions should be eaten as fresh, frozen or dried produce.
- Try to eat some meat, fish, eggs, beans and other non-dairy sources of protein as part of a healthy, balanced diet.

It is recommended that people who eat more than 90 g of red meat or processed meat per day should try and reduce their intake to 70 g per day. This advice is based on recommendations from the Scientific Advisory Committee on Nutrition (SACN), who examined the evidence for the association between red meat and processed meat, and the risk of colorectal cancer as part of their *Iron and Health* report (2011).

Aim for at least two portions of fish per week, including a portion of oily fish. A portion is about 140 g. This advice is derived from a review of the scientific evidence, which suggests that fish consumption is associated with a reduced risk of CVD. The portion size for fish is based on that which would provide the recommended amount of long-chain n-3 polyunsaturated fatty acids detailed in the Scientific

Advisory Committee on Nutrition, Committee on Toxicity (SACN, COT) 2004 report *Advice on fish consumption: benefits and risks*. That recommendation is 0.45 g/day LC n-3 PUFA.

Table 40 Rough guide to portion sizes in the United Kingdom

Vegetables and fruit	Guide to portion sizes
Vegetables	Raw, cooked, 2–3 tablespoons or 8–12 teaspoons frozen or canned
Salad	One dessert bowlful
Grapefruit, avocado, pear	Half fruit
Apples, bananas, oranges	One fruit and other citrus fruit
Plums and similar-sized fruit	Two fruit
Grapes, cherries and berries	One cupful or a handful
Fresh fruit salad, stewed	2–3 tablespoons canned fruit (including a little juice or syrup)
Dried fruit (raisins, apricots, etc.)	1.5–1 tablespoonful
Fruit juice: one glass	150 ml

United Kingdom (England)

Grains (cereal) products

The grains (cereal) groups identified in UK dietary guidance comprise rye, maize, cornmeal, polenta, millet, spelt, couscous, bulgur wheat, pearl barley, yams and plantains. The foodstuffs identified are bread, rice, potatoes, pasta and other starchy foods. The breads include soda bread, rye bread, pitta, flour tortilla, baguettes, chapatti and bagels. The remaining foods are rice, potatoes, breakfast cereals, oats, pasta, noodles, maize, cornmeal, polenta, millet, spelt, couscous, bulgur wheat, pearl barley, yams and plantains.

Fruit and vegetables

The vegetables identified in UK dietary guidance comprise all fruit and vegetables, including apples, pears, oranges, bananas, grapes, strawberries, mangos, pineapples, raisins, broccoli, courgettes, cabbage, peas, sweetcorn, lettuce, tomatoes and carrots. The produce may be fresh, frozen, tinned, dried or juiced. A portion is 80 g, or any of the following: one apple, banana, pear, orange or other similar-sized fruit; three heaped tablespoons of vegetables; a dessert bowlful of salad; a glass (150 ml) fruit juice. However, fruit juice counts as one portion no matter how much is consumed per day, the remaining portions should be eaten as fresh, frozen or dried produce.

Lean meats, poultry, and fish

The meats, poultry, fish, beans and pulses identified in UK dietary guidance are lamb, beef, pork, chicken, bacon, sausages, burgers; white fish (fresh, frozen or canned), including haddock, plaice, pollock, coley, cod; oily fish (fresh, frozen or canned), including mackerel, sardines, trout, salmon, whitebait; shellfish (fresh, frozen or canned) including prawns, mussels, crab, squid, oysters; eggs; nuts; beans and other pulses including lentils, chickpeas, baked beans, kidney beans, butter beans.

The Department of Health's advice is to aim for at least two portions of fish per week, including a portion of oily fish. It advises that most people should eat more fish, but there are recommended limits for oily fish, crab and some types of white fish. Some types of meat are high in fat, particularly

saturated fat. So, when buying meat, remember that the type of cut or meat product chosen, and how it is cooked, can make a big difference to fat intake.

The Department of Health also includes advice to cut down on fat. As follows: choose lean cuts of meat and go for leaner mince, cut the fat off meat and the skin off chicken; try to grill meat and fish rather than frying it; try not to eat too many sausages, meat pies and salami, because these are often high in fat; have a poached egg or a boiled egg instead of a fried egg.

Beans, peas and lentils (which are all types of pulses) are good alternatives to meat because they are naturally very low in fat, and are high in fibre, protein, and vitamins and minerals.

Milk and dairy foods

The milk and dairy foods identified in the UK dietary guidance comprise milk, cheese, yogurt, fromage frais, cottage cheese, cream cheese and quark. Recommendations on the milk and dairy foods identified in the UK dietary guidance are to try to eat some milk and dairy foods every day.

Food and drinks high in fat and/or sugar

The food and drinks that are high in fat and/or sugar are cakes, sugary drinks, biscuits, chocolate, sweets, puddings, pastries, ice cream, jam, honey, crisps, butter, margarine and spreads, oil, cream and mayonnaise. The Department of Health advice is to eat just a small amount of these foods. It also notes that much of the refined sugars consumed come from sugary fizzy drinks, chocolate and sweets, so it is a good idea to reduce consumption of these foods. Healthy snacks between meals may include fruit, wholemeal toast, low-fat yogurt or a few unsalted nuts.³⁷

Additional dietary intake recommendations and messages

Eat plenty of bread, rice, potatoes, pasta and other starchy foods every day. Choose wholegrain varieties when possible. Eat plenty of fruit and vegetables. Aim for at least five portions of a variety of fruit and vegetables each day. There is evidence to suggest that people who eat lots of fruit and vegetables are less likely to develop chronic diseases such as CHD and some types of cancer. Remember not to include potatoes when you are adding up your portions of fruit and vegetables, because these count as starchy foods.

Eat some milk and dairy foods every day. Choose lower-fat options when possible, or have just a small amount of the high-fat varieties less often. Butter and cream are not included in the milk and dairy food group because they are high in fat. – they belong to the group ‘foods and drinks high in fat and/or sugar’.

Eat some meat, fish, eggs, beans and other non-dairy sources of protein every day. Eat at least two portions of fish per week, including a portion of oily fish. Beans and other pulses fit in this group and they also fit in ‘fruit and vegetables’. But the pulses count as a maximum of one portion of fruit and vegetables per day.

Eat just a small amount of foods and drinks that are high in fat and/or sugar. Cutting down on these types of food could help control weight because they are calorie dense. Sugary foods and drinks can cause

tooth decay, particularly if eaten between meals, so consuming fewer of these foods and drinks could also protect teeth.

Additional dietary tips include the following: check the labels on different types of bread and try to choose the one lower in salt; compare different breakfast cereals and choose the ones lower in salt and sugar. If you are preparing chips, cook them in the oven rather than deep fry them. When cooking or serving starchy food, try to avoid adding too much fat (e.g., by spreading too much butter, margarine or spread on bread) or adding rich sauces and dressings (e.g., cream or cheese sauce on pasta).

Try to eat as many different types of fruit and vegetables as possible. Always keep some fruit close at hand to snack on if you are hungry. Keep some frozen vegetables in the freezer (for those occasions when you do not have ready access to fresh vegetables). When cooking or serving fruit and vegetables, try to avoid adding fat or rich sauces (e.g., carrots glazed with butter or parsnips roasted in a lot of fat), or adding sugar or syrupy dressings (e.g., stewed apple with sugar or chocolate sauce on banana).

Try switching to lower-fat milk, such as 1% fat milk. Compare labels on yogurts and try to choose the ones lower in saturated fat and sugars. Try to use low-fat yogurt or fromage frais instead of cream, soured cream or crème fraîche. 'Keep an eye on cheese consumption' – most types of cheese are high in saturated fat and salt.

The Department of Health's advice is to try and not add extra fat or oil when cooking and serving foods. When buying meat, ask the butcher for a lean cut, or compare the labels on different products and choose the one that is lower in saturated fat. 'Watch out for meat and fish products in pastry, batter or breadcrumbs' – these can be high in fat and/or salt.

Instead of sugary, fizzy drinks and juice drinks, choose water or unsweetened fruit juice (remember to dilute the unsweetened fruit juice for children). Or try diluting fruit juice with sparkling water. Instead eating cakes or biscuits, choose a currant bun or some malt loaf with low-fat spread. Use a reduced-fat spread instead of butter. When cooking, use just a small amount of unsaturated oil such as sunflower oil, rapeseed oil or olive oil, rather than butter, lard or ghee. For people who add sugar to their hot drinks or breakfast cereal, the Department of Health recommendation is to gradually reduce the amount of added sugar until it is eliminated altogether.

How does Ireland compare to the UK?

The UK adopts a different approach to developing FBDGs. The detail contained in the UK guidelines does not allow comparisons with Ireland.

UK – Summary

The UK (England) does not provide recommendations on serving sizes stratified according to the age-sex-activity levels of population subgroups. Rather, it provides calculation of segment size based on quantitative guidelines for the consumption of foods within each of the five food groups, in order to ensure a diet that is consistent with the UK Dietary Reference Values. Advice is given using the eatwell plate (Figure 22), a key policy tool which defines the Department of Health's recommendations on a healthy diet. The eatwell plate provides a visual representation of the types and proportions of foods needed for a healthy, balanced diet i.e., plenty of starchy foods; fruit and vegetables; some milk, dairy,

meat, fish and other non-dairy sources of protein; and only small amounts of food and drinks that are high in fat and/or sugar.

The recommendations are as follows: eat at least five portions of a variety of fruit and vegetables every day; eat some meat (people who eat more than 90 g of red meat or processed meat per day should reduce their intake to 70 g per day); eat fish (two portions of fish per week, including one portion of oily fish); eat eggs, beans and other non-dairy sources of protein as part of a healthy, balanced diet.

The key targeted messages are as follows: eat plenty of bread, rice, potatoes, pasta and other starchy foods every day; choose wholegrain varieties when possible; eat plenty of fruit and vegetables (at least five portions of a variety of fruit and vegetables each day, not including those that count as starchy foods); consume lower-fat options of some milk and dairy foods every day. Finally, eat just a small amount of foods and drinks that are high in fat and/or sugar.



Figure 22 The UK eatwell plate

Section 7: Mapping of the dietary recommendations of the Irish Department of Health with recommendations from the USA, Canada and Australia

Background

This section compares the recommended dietary intake for females in Ireland with females in Canada and Australia for specific age groups and activity levels; it also compares recommendations from the USA according to specific calorie intake ranges. Females aged 19–50 years are compared across countries. There are differences in the aggregated comparative age group ranges between countries. The published composite data for Ireland and Australia present dietary information for the age range 19–30 years. The published composite data for Canada present dietary information for the age range 19–50 years. Country-specific differences also exist with regard to published dietary recommendations for various activity levels. Ireland's dietary recommendations are calculated for both sedentary and active lifestyles. Canada's dietary recommendations are calculated for sedentary lifestyles. Australia's dietary recommendations are calculated for a range of activity levels from sedentary to very active. The Australian values reported on in this section are for a physical activity level (PAL) 1.7 as representative of an intermediate activity level lifestyle.

Dietary recommendations are published in two formats. As follows:

- The first format presents food group clusters within their individual food shelves, with instructions as to the daily (or weekly) number of recommended servings. Individuals choose the number of recommended servings from the food types of each food group presented on successive shelves, in order to achieve their recommended targeted intake. This is the format adopted in Ireland and Canada.
- The second format follows the same principles, but additionally presents a series of structured dietary recommendations which allows a certain amount of 'food substitution between shelves'. This is the format adopted in Australia. Australia additionally publishes a variety of diets for each age-activity-level-specific group, in order to provide nutrition and diet advice. The ability to substitute the number of servings from a particular but different food group presents a more scientific assessment of 'food substitution' than would be possible if individuals attempted substitution themselves.

The age-specific examples of daily recommended dietary servings from the four food groups (as well as recommended dietary servings of oils and fats, and extras or discretionary foods for females from the four countries) are presented in Figure 23. The recommendations are for the four food groups (grains, vegetables and fruit, milk and alternatives and meats and alternatives) and for the additional groups of 'oils and fats', and 'extras, leeway or discretionary foods'.

It should be noted that while it was not possible to make comparisons with data from the UK, due to the lack of portion size advice, the Irish and UK guidelines are similar in relation to portions of fruit and vegetables, and also in relation to the inclusion of potatoes in the 'grains' group (i.e., bread, cereals and potatoes) in the UK. (Mwatsama, M 2014 Personal Communications)

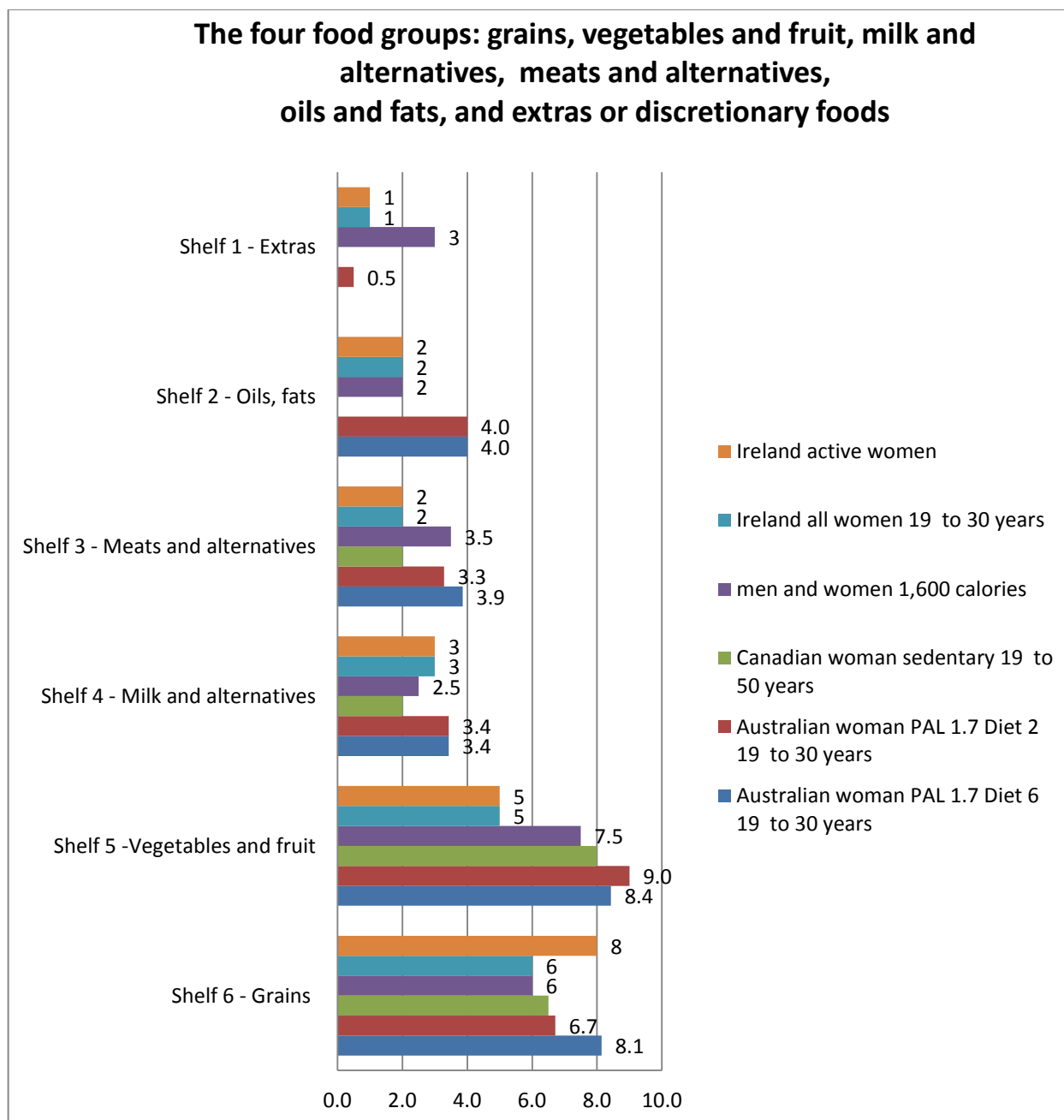


Figure 23 Daily recommended dietary servings from the four food groups, oils and fats, and extras or discretionary foods

Recommended number of servings for specified age-sex-activity levels

- Grains servings recommendations ranged from 6 to 8.1 servings per day. The recommended range of servings by the Irish Department of Health fit with the recommendations of Canada for women with a sedentary lifestyle, and with the recommendations of the USA for women with a 1,600 calorie intake. The upper and lower limits also fit within the range of recommendations made in the two reported Australian diets for women with a PAL 1.7. It should be noted that Ireland, unlike other countries, includes potatoes with grains on the bottom shelf. By contrast,

in the five countries reviewed, grains are presented separately and potatoes are in the vegetable section.

- Fruit and vegetables servings recommendations range from five to nine servings per day. Ireland, with a recommendation of five servings per day for both sedentary and active women, had the lowest recommended number of fruit and vegetables servings of all countries reviewed. The next lowest number of recommended servings for this category was for the USA (7.5 servings). By contrast, in Australia, the recommended number of servings of fruit and vegetables per day is nine.
- Milk and milk alternatives servings recommendations ranged from 2 to 3.4 servings per day. Ireland, with a recommendation of three servings per day for both activity levels, was just over the average (mean) of recommendations from all other countries.
- Meats and alternatives servings recommendations ranged from two to almost four servings per day. Ireland, with a recommended number of two servings per day for both groups, matched Canada's servings recommendations for a sedentary lifestyle. However, the Canadian recommendation is lower than the number of recommended servings specified in the Australian and US guidelines.
- Oils and fats servings recommendations ranged from two to four servings per day, or none. Canada's recommendations on oils or fats are provided separately from the daily serving recommendations; they are provided in the statement 'the eating pattern also includes a small amount (30–45 ml or about 2–3 tablespoons) of unsaturated fat each day'. For the remaining countries, Ireland and the USA, the recommendation of two servings of oils and fats per day is half the recommended number of servings allowed in Australia.
- Extras, leeway, discretionary or SoFAS foods servings recommendations ranged from 0.5 to 3 servings per day, or none. Canada did not make recommendations on the consumption of extras, leeway or discretionary foods. Ireland's recommendation of a maximum of one serving per day, the USA's recommendation of up to three servings per day, and the recommendation of 0.5 servings per day in Australia, were all presented as 'extras' to the required dietary intake, notwithstanding the fact that the calorie contribution of these foods is part of the daily calorie allowance.

We compared the Irish Department of Health's daily servings recommendations with respect to four food groups (grains, fruit and vegetables, milk and alternatives, and meats and alternatives), for oils and fats, and for extra, leeway, discretionary or SoFAS foods for females in the 19–50 years age range, who have sedentary or moderate activity levels, with recommendations in Australia, Canada and the USA. We found that, broadly speaking, the Irish Department of Health's dietary recommendations, with the exception of fats and the inclusion of potatoes on the grains shelf, do not differ substantially from the recommendations of other countries that have populations with similar characteristics. Differences in food group composition serving sizes – and the extent to which fats and oils and extras, leeway, discretionary or SoFAS foods were considered as integral to the diet – were observed to exist between countries.

Further comparisons are presented in Figure 24 and Figure 25. In Figure 24 the inter-country comparison for persons with a sedentary lifestyle recommend between 6 and 6.5 servings of grains, 5–8 servings of vegetables and fruit, 2–3 servings of milk and alternatives, and between 2 and 3.5 servings of meats and alternatives. It should be noted that the inclusion of potatoes on the grains shelf in the Irish food pyramid represents a variation in the underlying grouping of grains, and fruit and vegetables, which differs to that adopted by the USA or Canada. Ireland and the USA make recommendations on the additional groups 'oils and fats', and 'extras, leeway or discretionary foods' No

difference was observed with respect to oils and fats, at two servings each per day. However, the Irish allowance on discretionary foods at one serving per day is one-third of the US allowance.

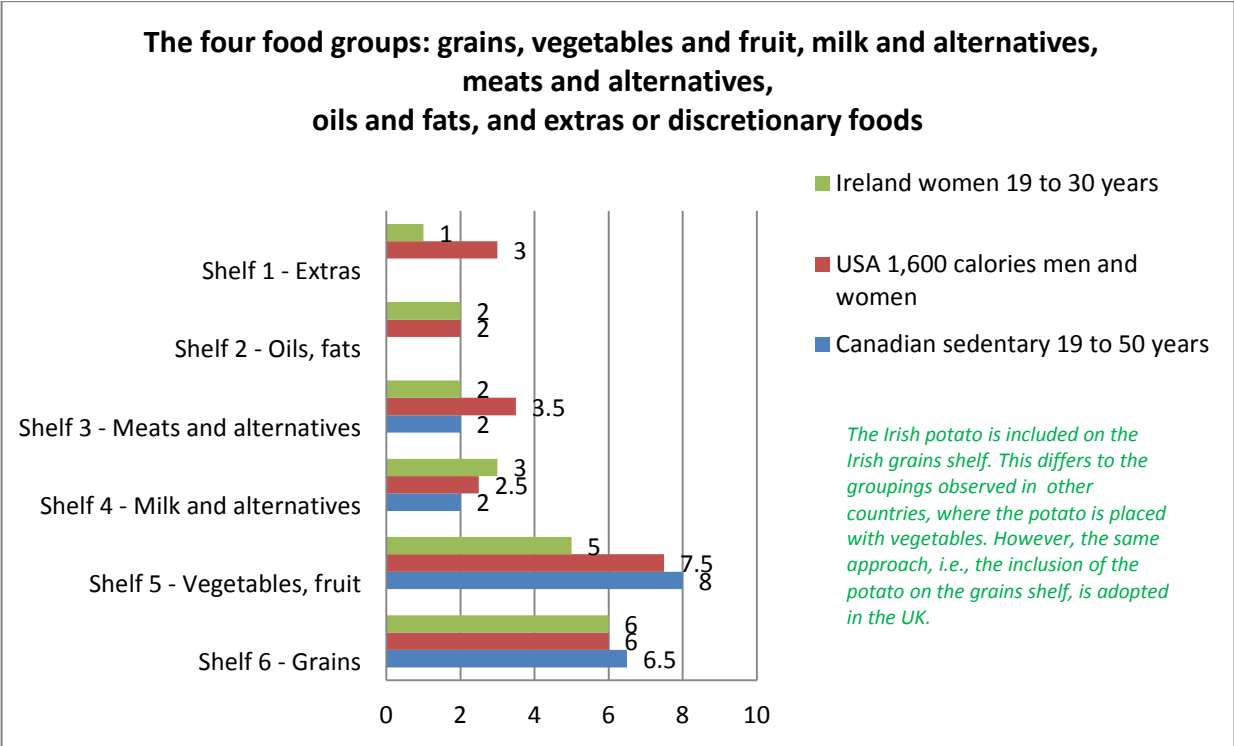


Figure 24 The four food groups. Sedentary lifestyle: a three inter-country comparison

In Figure 25, the inter-country comparison for a person with an active lifestyle recommended between 6.7 and 8 servings of grains, 5–9 servings of fruit and vegetables, between 3 and 3.4 servings of milk and alternatives, and between 2 and 3.3 servings of meats and alternatives. A two-fold difference was observed with regard to oils and fats, at 2–4 servings each per day; however the Australian allowance on discretionary foods at 0.5 servings per day was a half of the Irish allowance.

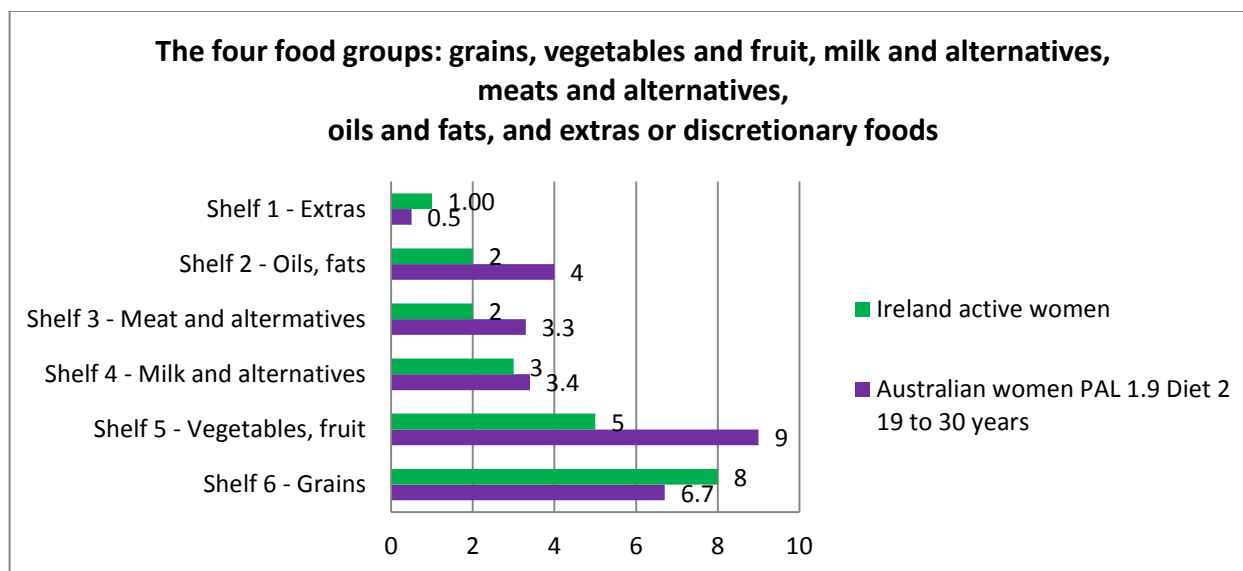


Figure 25 The four food groups. Active lifestyle: a two inter-country comparison

Explanation of differences

Broadly speaking, the Irish Department of Health's dietary recommendations do not differ substantially from recommendations of other countries for populations with similar characteristics (age-sex-activity level).

However, there are exceptions to this, as observed in relation to a number of recommendations, for example, those on:

1. extrinsic fats and oils (not made by Australia and Canada for sedentary lifestyles)
2. discretionary foods (not made by Australia and Canada for sedentary lifestyles)
3. the inclusion of potatoes on the grains (versus vegetables) shelf in the Irish food pyramid
4. the recommendation on vegetables intake are somewhat lower in the Irish diet.

Differences in food group composition serving sizes – and the extent to which fats and oils and extras, leeway, discretionary or SoFAS foods are considered as integral to the diet – limit the ability to undertake accurate statistical comparisons because the data used represent composites rather than raw variable measures. This factor required the HRB authors to focus on a descriptive rather than statistical like-with-like comparison than would have been possible if raw data were available. Many of the caveats which should be considered when interpreting results are summarised in Table 41.

Identification of major differences

Differences in the underlying nutritional, socio-political and cultural criteria for bundling foods; the diet-health relationships considered to be of public health relevance; limiting the provision of dietary advice to essential foods only, or making it inclusive of discretionary intake; variations in age range groupings,

climatic conditions and contemporary food consumption patterns – these represent just some of the variations that must be considered when seeking to make inter-country comparisons (see Table 41).

Table 41 Caveats for consideration when interpreting reported dietary recommendations

General note on comparisons and some specific examples
<p>NOTE: Differences in age groups (19–30 years and 19–50 years) and activity levels are important caveats (confounders) in interpreting findings between countries. In principle, it means that comparisons are being made between heterogeneous (dissimilar) rather than homogenous (similar) groups. This illustrates the requirement to analyse raw data in order to create truly meaningful comparisons. Thus, the comparisons made and reported here should be considered as robust (broadly comparable) descriptive cross-country comparisons, and not as a scientific assessment of dietary intake.</p>
<ol style="list-style-type: none"> 1. Servings or portion size recommendations are not the same in all countries reviewed. 2. Food group bundling differs across countries. 3. Not all countries include recommendations on oils and fats and/or discretionary food groups. 4. US reporting of dietary recommendation are made according to calorie intake levels and not, as reported by other countries, by age-sex-activity level. 5. Inferences from the reported population subgroup of female adults cannot be extrapolated to population groups of a different age-sex-physical activity level.

Summary

In this section age sex-specific inter-country comparisons are made between the daily recommended dietary servings for the four food groups (grains, fruit and vegetables, milks and alternatives and meats and alternatives) and for 'oils and fats' and 'extra, leeway or discretionary foods'. The comparison population is females aged 19–50 years of sedentary or moderately active lifestyle in Ireland, Canada, Australia and the USA. The manner of (food group) data aggregation prevents a statistical inter-country comparative assessment. In place of the more rigorous statistical comparison a mapping process, matching *roughly* comparable food group servings recommendations, was undertaken.

The Irish Department of Health's recommendations are compatible with the following: Canada and the USA with respect to grain products; Canada with respect to meats and alternatives; they represent the average (mean) recommendations of all countries with respect to milk and alternatives, and are lower than for all other countries with respect to recommendations on fruit and vegetables. Irish 'oils and fats' recommendations match US recommendations; they are half of the Australian recommendations. Irish recommendations on 'extra, leeway or discretionary foods' (one serving per day) exceed the Australian recommendation of 0.5 servings per day; however, the Irish recommendations are lower than the US recommendation of three servings per day.

Differences in study methodologies between countries, such as characteristics employed in determining food groups and the parameters used in population characteristic boundaries (for example, the upper and lower ages for different age groups) determine the strength of the inferences to be drawn from mapping recommendation between countries.

Section 8: Issues that limit the ability to undertake statistical comparisons of food-based dietary guidelines (FBDGs)

Certain issues need to be considered when comparing the foods and the resulting food-based dietary guidelines of two or more countries, and any comparisons made must take a number of caveats into account. Table 42 lists a range of considerations or questions that need to be taken account of when comparing recommendations and guidelines between different populations.

Table 42 Issues that limit the ability to undertake the statistical comparisons of the food-based dietary guidelines (FBDGs) of two or more countries

Some criteria to be considered when assessing compatibility
<p>Food composition databases: points for consideration:</p> <ol style="list-style-type: none"> 1. Do the data presented represent raw, processed or prepared foods? 2. What are the national food fortification policies? 3. If using non-national composition databases, is regularly consumed, popular, manufactured food produces adequately represented? <p>Survey databases: points for consideration</p> <ol style="list-style-type: none"> 1. Is adequate information on dietary intake patterns provided? 2. Is adequate information on relevant measures of anthropometry provided? 3. Have baseline measures – against which the effectiveness of targeted interventions are to be measured – been established? <p>Determination of food consumption patterns: points for consideration</p> <p>What data analyses were used for:</p> <ol style="list-style-type: none"> 1. Review of existing information or data <ol style="list-style-type: none"> a. <i>a priori</i> (based on prevailing knowledge concerning favourable or adverse effects of various dietary constituents), e.g., factor analysis, or b. <i>a posteriori</i> (data driven) e.g., cluster analysis, or 2. A theoretical model predicting daily or weekly dietary intake, based on assumptions and existing experience <p>Degree of specificity: points for consideration</p> <ul style="list-style-type: none"> • Diet types: omnivore, Mediterranean, vegetarian, vegan • Age • Sex • Weight and height • Exercise level • Climate • Numeric parameters: baseline, average, range <p>Key issues and messages with regard to:</p> <ul style="list-style-type: none"> ○ fruit and vegetables ○ meats and alternatives ○ milk and alternatives ○ discretionary, leeway or SoFAS foods ○ physical activity ○ frequency of consumption ○ portion or serving sizes ○ mix of foods

Chapter 6: Question 3

Review of the fats and carbohydrate seesaw effect as well as current evidence on the relationships between carbohydrates and/or fats and heart disease

Fats and carbohydrate seesaw effect

In the late 1980s (Committee on Medical Aspects of Food Policy) and in the early 1990s³⁸ a phenomenon was noted in observational studies. That phenomenon was that there is an inverse linear association between the percentage energy intake of fat when consumed with sugars: simply put, as the percentage of energy from fat in the diet decreases, the percentage of energy from sugar increases, and vice versa.

A number of authors hypothesised that, in freely chosen diets, reducing energy intake from both fats and sugars at the same time, in order to comply with dietary guidelines, may be difficult for populations to achieve. Of note, the recent systematic review³⁹ examining this hypothesis – a review which was funded by a grant from the UK's Sugar Bureau – interpreted the evidence as supportive of an inverse correlation between percentage of energy from total sugars and percentage of energy from total fats and, separately, total sugars and unsaturated fats, as well as extrinsic sugars (refined or added sugars) and total fats. However, the percentage energy relationship between sucrose and total fats in the one study identified demonstrated a positive, unadjusted correlation. That correlation was that as sucrose intake increased, so also did total fat intake. In addition, there was no correlation between the percentage energy relationship between extrinsic sugars (refined or added sugars) and saturated fats; in other words, increasing extrinsic sugar did not affect saturated fat intake.

Other authors^{40, 41} have stated that the inverse relationship is an inevitable mathematical consequence, as opposed to something that is influenced by dietary choice; in other words, it is an issue of weight rather than proportion. Horgan *et al.* caution that comparing quantity in percentage (energy) terms alone can be misleading, and it is only when examining absolute values (weight) as well as percentage contribution to energy that the interrelationships between macronutrients (such as fat and sugar) can be studied fully.

Horgan and Whybrow⁴¹ in a 2012 paper examined the associations between macronutrient intakes in the diets of adults (n = 1,724) participating in the UK National Diet and Nutrition Survey, as well as such intakes in the same adults across different days of the week. Pearson's correlations were calculated between the macronutrient intakes from fats, total sugar, intrinsic sugars (natural unrefined sugars), non-milk extrinsic sugars (refined or added sugars), non-sugar carbohydrate, protein and alcohol. Energy intakes relative to estimated basal metabolic rate (BMR) were calculated to partially account for differences in energy requirements. Pearson's correlations also examined associations between the same macronutrients in foods from the Nutrient Databank that were used to analyse dietary intakes in the UK National Diet and Nutrition Survey. Correlations between fats and sugar(s) were calculated in five ways:

1. percentage energy between individuals
2. amount (of food in grams) between individuals

3. amount (of food in grams) relative to BMR between individuals
4. within individuals over seven days
5. between food items in the Nutrient Databank.

As expected, negative correlations were obtained between mean daily percentage energy intakes of fats and total sugars, extrinsic sugars and intrinsic sugars (all $p < 0.001$); as fats decreased sugars increased and *vice versa*. However, when mean daily macronutrient intakes were expressed in weight grams per day, these were all positively correlated (all $P < 0.001$); as fats increased sugars increased. Mean estimated correlations between macronutrient intakes (grams per day) for each individual across the days of the week were also positive, indicating (according to the authors) an absence of the fat-sugar seesaw effect. Within the Nutrient Databank, the correlation between fats and total sugar (grams per 100 g of food) was weakly positive ($P = 0.006$). Only when the correlation between fats and sugar(s) between individuals in percentage terms (% energy) was examined was the fat-sugar seesaw effect evident; for all other methods the correlations between fats and sugar(s) indicated that they increased or decreased together.

The authors conclude that "examination of the effects of using percentage energy values to describe the macronutrient composition demonstrated that the fat-sugar seesaw effect is only an inevitable mathematical consequence, rather than the result of dietary choice. "

According to Horgan and Whybrow, the question that needs to be asked is why is this percentage energy seesaw effect important? They state it matters if it affects the population's health status and if people cannot assimilate more than one message in food dietary guidelines.

Relationships between carbohydrates and/or fats and heart disease

In 2010, the European Food Safety Authority² reported in its dietary reference values for nutrient intake document that 'evidence is still inconclusive on the role of **glycemic index** and **glycemic load** in maintaining weight and preventing diet-related **disease**' or chronic diseases, in particular **coronary heart disease (CHD)**. The glycemic index (GI) and glycemic load (GL) concepts have been developed to characterise food behaviour during human digestion. The European Food Safety Authority ranks carbohydrate-rich foods based on the rapidity and magnitude of their effect on blood sugar levels. GI is a measure of how quickly food glucose is absorbed, while GL is a measure of the total absorbable glucose in foods. GI is expressed as a percentage, and represents the relative rate of glucose absorption into the blood based in this study on the absorption one slice of white bread (one slice = 50 g). GL calculated from the GI reflects a whole day's intake on expected postprandial blood glucose changes. It represents the type of carbohydrate eaten, together with the quantity of food consumed. Consequently, GL can be a better predictor of postprandial response to carbohydrate foods and insulin secretion than GI. The GI for each individual is computed by dividing the GL by the total carbohydrate intake per day. Using the terms GI, GL and diet-related disease to guide a search strategy, the authors found a number of additional studies and reviews examining this relationship.

Glycaemic load and glycemic index and their relationship with CHD

The HRB authors report the finding of the two systematic reviews which undertook a meta-analysis to evaluate the above relationship, using the individual studies identified to answer to question 3.

Mirrahimi *et al.* (in 2012)⁴² evaluated the association **between GI, GL and CHD risk in 10 prospective cohort studies** using meta-analysis. The results for men indicated that there was not a significant increase in CHD risk for the highest GI quantile, compared with the lowest quantile, with relative risk (RR) =0.96 (95% CI 0.84 to 1.11) and for GL, RR=1.08 (95% CI 0.93 to 1.26). The results for women indicated a significant increase in CHD risk for the highest GI quantile compared with the lowest, with RR=1.26 (95% CI 1.12 to 1.41) and for GL RR=1.55 (95% CI 1.18 to 2.03). **High GI and GL diets were significantly associated with CHD events in women, but not in men.**

Fan *et al.* (in 2012)⁴³ completed a meta-analysis to determine the **relationship between dietary GI, GL and risk of CHD, stroke, and stroke-related mortality. They included 15 prospective studies** with exposures of GI and GL, and outcome of incidence of fatal and non-fatal CHD and stroke, and stroke-related mortality. Fifteen prospective studies with a total of 438,073 participants and 9,424 CHD cases, 2,123 stroke cases, and 342 deaths from stroke were included in the 15 studies. Their findings were the same as those made by Mirrahimi *et al.* i.e., that sex significantly modified the effects of GI and GL on CHD risk, and high GI (relative risk [RR] = 1.25, 95%CI 1.12–1.39) and high GL level (RR = 1.49, 95%CI 1.27–1.73) were associated with higher risk of CHD in women, but not in men (GI RR = 0.99, 95%CI 0.88–1.12, GL RR = 1.08, 95%CI 0.91–1.27). Stratified meta-analysis by BMI indicated that among overweight and obese subjects, dietary GL level was significantly associated with increased risk of CHD (p for interaction = 0.003). There is a linear dose-response relationship between dietary GL and increased risk of CHD, with pooled RR of 1.05 (95% CI 1.02–1.08) per 50-unit increment in GL level. Higher dietary GL (RR = 1.19, 95% CI 1.00–1.43) and high GI (RR = 1.09, 95% CI 0.94–1.26) was not significantly associated with stroke. **High GI and GL were not significantly associated with stroke in the one meta-analysis where the outcome was examined.**

In two recent systematic reviews, **high-GI and high-GL diets were significantly associated with CHD events in women, but not in men. High GI and GL were not significantly associated with stroke in the one meta-analysis where the outcome was examined.**

Fats substituted with each other and carbohydrates

Jakobsen *et al.* (2009)⁴⁴ investigated **associations between energy intake from monounsaturated fatty acids (MUFAs), polyunsaturated fatty acids (PUFAs), and carbohydrates and risk of CHD** while assessing the potential effect modifying role of sex and age. Using substitution models, their aim was to clarify whether energy from unsaturated fatty acids or carbohydrates should replace energy from saturated fatty acids to prevent CHD. This was a follow-up study in which data from **11 American and European cohort studies** were pooled. The outcome measure was incident CHD. During 4–10 years of follow-up, 5,249 coronary events and 2,155 coronary deaths occurred among 344,696 persons. For a 5% lower energy intake from saturated fatty acids and a concomitant higher energy intake from PUFAs, there was a significant inverse association between PUFAs and risk of coronary events (hazard ratio: 0.87; 95% CI: 0.77, 0.97); the hazard ratio for coronary deaths was 0.74 (95% CI: 0.61, 0.89). For a 5% lower energy intake from saturated fatty acids and a concomitant higher energy intake from carbohydrates, there was a modest significant direct association between carbohydrates and coronary events (hazard ratio: 1.07; 95% CI: 1.01, 1.14); the hazard ratio for coronary deaths was not significant (hazard ratio: 0.96; 95% CI: 0.82, 1.13). MUFA intake was not associated with CHD. No effect modification by sex or age was found. **The findings suggest that replacing saturated fatty acids with PUFAs, rather than MUFAs or carbohydrates prevents CHD, over a wide range of intakes.** A subsequent review in 2010⁴⁵, which examined the relationship between polyunsaturated fat and saturated fats in randomised control

trials, concluded that **consuming PUFAs in place of saturated fatty acids reduced CHD events** by 19% (0.81, 95% CI 0.70, 0.95).

Dietary saturated fat with risk of CHD and stroke

In 2010, Siri-Tarino *et al.*⁴⁶ completed a meta-analysis to summarise **the evidence related to the association of dietary saturated fat with risk of CHD and stroke in prospective epidemiologic studies**. Twenty-one studies were identified as being suitable for the review. Of these, 16 had CHD as an outcome and eight had stroke as an outcome. During 5–23 years of following up 347,747 subjects, 11,006 participants developed CHD or stroke. The risk among those who consumed extreme quantiles of saturated fat intake were compared with those who did not, and consuming extreme quantiles of saturated fat was not associated with CHD (1.07, 95% CI: 0.96, 1.19; $P = 0.22$), stroke (0.81, 95% CI: 0.62, 1.05; $P = 0.11$) or CVD (1.00, 95% CI: 0.89, 1.11; $P = 0.95$). Stratification by age or sex did not change the results. The authors conclude that there is no evidence in this analysis that the **intake of saturated fat was not associated with an increased risk of CHD and stroke**.

Replacement of fats with low-GI and high-GI carbohydrates

In 2010, Jakobsen *et al.*⁴⁷ **examined the risk of myocardial infarction associated with a higher energy intake from carbohydrates and a concomitant lower energy intake from saturated fatty acids, using substitution models**. Carbohydrates with different GI values were investigated. The prospective cohort study included 53,644 women and men with no incidence of myocardial infarction (MI) at baseline. During a median of 12 years of follow-up, 1,943 incident MI cases were observed. There was a weak or non-significant association between substitution of carbohydrates with low GI values for saturated fatty acids and risk of MI [hazard ratio (HR) per 5% increment of energy intake from low-GI carbohydrates: 0.88; (95% CI: 0.72, 1.07)]. In contrast, there was a statistically significant positive association between substitution of carbohydrates with high GI values for saturated fatty acids and risk of MI (HR: 1.33; 95% CI: 1.08, 1.64). There was no association for carbohydrates with medium GI values (HR: 0.98; 95% CI: 0.80, 1.21). No effect modification by sex was observed. **This study suggests that replacing saturated fatty acids with carbohydrates with low GI values (such as wholegrain products) may be associated with a possible lower risk of MI, whereas replacing saturated fatty acids with carbohydrates with high GI values (such as refined sugars) is associated with a higher risk of MI.**

Conclusion

Broadly speaking, the Department of Health's dietary recommendations do not differ substantially from the recommendations of other countries (Australia, Canada and the USA) for populations with similar characteristics – specifically, age-sex-activity level. However, there are exceptions to this, as observed in relation to a number of recommendations. For example:

1. Recommendations are made by the Department of Health to allow extrinsic fats and oils for those with sedentary lifestyles, whereas extrinsic fats and oils are not allowed for those with sedentary lifestyles in Australia and Canada.

2. Recommendations are made by the Department of Health to allow discretionary foods for those with sedentary lifestyles, whereas such high-sugar and high-fat foods are not allowed for those with sedentary lifestyles in Australia and Canada.
3. In Ireland, potatoes are included on the grains shelf, whereas they are classified as starchy vegetables in Australia, Canada and the USA, and this leads to a possible overestimate of the amount of grains consumed in Ireland, relative to the amount of grains consumed in the three comparison countries.
4. Recommendations on fruit and vegetables intake appear somewhat lower for the Irish diet, compared with the Australian, Canadian and the US dietary recommendations for fruit and vegetables intake.
5. The majority of countries recommend that more than half of grain intake should be in the form of whole grains rather than refined grains, and the images and key messages used in these countries' as health promotion materials demonstrate this practice. Australia recommends eating wholegrain products rather than discretionary products after engaging in moderate exercise. These messages may be useful in promoting healthy eating.
6. In Australia and Canada, the emphasis is on polyunsaturated fats rather than monounsaturated or saturated fats.

The fat-sugar seesaw relationship is a fallacy and does not merit any further consideration. However, avoidance of saturated fatty acid accumulation by reducing the intake of both carbohydrates and fats with a high GI is more effective in the prevention of CVD than reducing saturated fatty acid intake alone. The key messages in the FBDGs with respect to dietary fats are that they should be eaten in small amounts, and saturated fats should be substituted for, or replaced with, unsaturated fats (particularly PUFAs) or complex carbohydrates.

Note to readers on Website links

Report links in this review are included to assist the reader to access the relevant sites and are valid at the time of writing (September 2014). However, nation and international bodies may over time change the location of their publication. Where this occurs it is usually possible to access the publication of interest by entering the relevant publication name into the organisation's website or directly into your engine search box.

In a small number of cases – links for the food images – lead to Wikipedia sites, as English translations were not available for these images in the national website.

Appendix A

Table 43 International bodies' websites on food and nutrition

International bodies Website search Types of relevant websites and/or documentation identified	Weblink
World Food Programme*	http://www.wfp.org/nutrition
Report of a Joint FAO/WHO/UN Expert Consultation, Rome, Italy, 17–24 October 2001 <i>Human energy requirements</i> Publication date: 2004	http://www.who.int/nutrition/publications/nutrientrequirements/9251052123/en/
Report of a Joint FAO/WHO Expert Consultation 1997, Rome, Italy, 14–18 April <i>Carbohydrates in human nutrition</i> Publication date: 1998	http://www.who.int/nutrition/publications/nutrientrequirements/9251041148/en/
FAO FOOD AND NUTRITION PAPER <i>Food energy – methods of analysis and conversion factors</i>	ftp://ftp.fao.org/docrep./fao/006/y5022e/y5022e00.pdf
FAO <i>Fats and fatty acids in human nutrition Report of an expert consultation</i>	http://www.who.int/nutrition/publications/nutrientrequirements/fatsandfattyacids_humannutrition/en/
Report of a Joint WHO/FAO expert consultation <i>Diet, nutrition and the Prevention of Chronic Diseases</i> Publication Geneva 2003 WHO Technical Report Series, No. 916 (TRS 916)	http://www.who.int/dietphysicalactivity/publications/trs916/en/
FAO <i>Fats and fatty acids in human nutrition Report of an expert consultation</i> Publication date: 2010	http://www.who.int/nutrition/publications/nutrientrequirements/fatsandfattyacids_humannutrition/en/
World Health Organization	
Standards and the production of dietary guidelines/ Dietary recommendations / Nutritional requirements	http://www.who.int/nutrition/topics/nutrecommend/en/index.html
Nutrient. Nutrient requirements and dietary guidelines, and Dietary recommendations by geographic region	http://www.who.int/nutrition/publications/nutrient/en/index.html
European Food Safety Authority* Nutrition and health claims	http://www.efsa.europa.eu/
Opinion on principles for deriving and applying:	http://www.efsa.europa.eu/
<ul style="list-style-type: none"> Dietary reference values: scientific opinion on dietary reference values for water 	
<ul style="list-style-type: none"> Scientific opinion on establishing food-based dietary guidelines 	
<ul style="list-style-type: none"> Scientific opinion on dietary reference values for fats, including saturated fatty acids, polyunsaturated fatty acids, monounsaturated fatty acids, trans fatty acids, and cholesterol 	
<ul style="list-style-type: none"> Scientific opinion on dietary reference values for carbohydrates and dietary fibre 	

* Additional follow up by email and telephone

Table 44 Search terms

Databases		Search strategies
Google (N=25)	Australia, Austria, Belgium, Bulgaria, Canada, China, Croatia, Czech Republic, Estonia, France, Finland, Germany, Greece, Hungary, India, Ireland, Israel, Italy, Malaysia, Netherlands, Norway, Philippines, Sweden, United States of America, United Kingdom	'Country food pyramid' 'Country food-based dietary guidelines'
Google (N=11)	Japan, Korea, Latvia, Mexico, Portugal, Poland, Romania, Slovakia, Spain, Switzerland, Thailand	'Country food pyramid'
	Norway	Personal correspondence
	United Kingdom	Personal correspondence

Table 45 Country-specific government or agency publications on dietary guidelines identified for additional examination and reported on in this review

Countries	Follow up of references identified from the initial search of documents for data extraction	
Australia	<ol style="list-style-type: none"> 1. <i>Australian Dietary Guidelines – providing the scientific evidence for healthier Australian diets (2013)</i> 2. <i>Australian Dietary Guidelines – Summary</i> 3. <i>Eat for Health Educator Guide – Information for nutrition educators</i> 4. <i>Healthy eating for children – brochure</i> 5. <i>Healthy eating for adults – brochure</i> 6. <i>Australian Guide to Healthy Eating – poster</i> 7. <i>Eat for Health: Dietary guidelines for all Australians – poster</i> 	https://www.nhmrc.gov.au/guidelines/publications/n55
	8. <i>A modelling system to inform the revision of the Australian guide to healthy eating</i>	http://www.eatforhealth.gov.au/sites/default/files/files/public_consultation/n55a_dietary_guidelines_food_modelling_111216.pdf
Canada	<ol style="list-style-type: none"> 1. <i>Eating Well With Canada's Food Guide A Resource for Educators and Communicators</i> 2. <i>Canadian Nutrient File and Nutrient Value of Some Common Foods</i> 3. <i>Simulating the Nutrient Distribution of Dietary Patterns for the Revision of Canada's Food Guide</i>^{48, 49} 	http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/educ-comm/resource-ressource-eng.php
Sweden	1. <i>National Food Agency Swedish Nutrition Recommendations Objectified (SNO) – Basis for general advice on food consumption for healthy adults</i>	http://www.slv.se/en-gb/ http://www.slv.se/upload/dokument/rapporter/mat_naring/Report_20_2005_SNO_eng.pdf
United States of America	1. <i>Dietary Guidelines for Americans 2010</i>	http://www.cnpp.usda.gov/DGAs2010-PolicyDocument.htm http://www.cnpp.usda.gov/dietary-guidelines-2010
United Kingdom	1. <i>The balance of good health. Information for educators and communicators</i>	http://multimedia.food.gov.uk/multimedia/pdfs/bghbooklet.pdf
New Zealand	<ol style="list-style-type: none"> 1. <i>Food and Nutrition Guidelines for Healthy Children and Young People (Aged 2-18 Years) – A background paper (August 2012)</i> 2. <i>Food and Nutrition Guidelines for Healthy Adults – A Background paper (October 2003)</i> 3. <i>New Zealand Food and Nutrition Guideline statements</i> 4. <i>Food and Nutrition Guidelines for Healthy Older People – A Background Paper (2010 – revised January 2013)</i> <p>Websites <i>Eating for Healthy Children aged 2 to 12</i> – HealthEd website <i>Healthy Eating for Young People</i> – HealthEd website <i>Eating for Healthy Adult New Zealanders</i> – HealthEd website</p>	http://www.health.govt.nz/our-work/preventative-health-wellness/nutrition/food-and-nutrition-guidelines

	Eating Well for Healthy Older People – HealthEd website	
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Table 46 Systematic journal review according to stated years – all abstracts read

Journals reviewed		
1. <i>Advances in Nutrition: An international Review Journal</i>	January 2010 to December 2014	January 2014
2. <i>The Annual Review of nutrition</i>	January 2010 to December 2014	January 2014
3. <i>Critical Reviews in Food Science and Nutrition</i>	January 2010 to December 2014	January 2014
4. <i>Family Economics and Nutrition Review</i>	January 2010 to December 2014	January 2014
5. <i>Nutrition Health Review</i>	January 2010 to December 2014	January 2014
6. <i>Nutrition Research Reviews</i>	January 2010 to December 2012, 2014	January 2014
7. <i>Nutrition reviews</i>	January 2010 to December 2014	January 2014

Table 47 Additional food composition databases

Country	
United States of America	http://ndb.nal.usda.gov/ndb/search/list

Appendix B

Table 48a WHO and country-specific food-based dietary guidelines details

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micronutrients	Physical activity, alcohol, diet, weight/BMI
1.WHO/CINDI* *Country-wide integrated non-communicable disease intervention 2000	Pyramid (2000)	Four groups, Three levels	Level 1 or bottom shelf: Cereals, fruit and vegetables (mixed). No instructions on number of servings or serving size	Level 3: Fats and oils (and other refined sugars)	Green, orange and red background colour helps to indicate relative importance of each group in the model. Green for proceeding. Orange for caution. Red for stop to consider			Salt included in separate 12 steps to healthy eating		Advice on, physical activity included in the 12 steps. The graph format contains four active individual figures. Advice on, alcohol included in the 12 steps

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micronutrients	Physical activity, alcohol, diet, weight/BMI
					before consuming					
Australia	Plate (2013)	Five groups	Level 1: Cereals 33%. Level 2: Vegetables 33% Level 3: Fruit 11%. No instructions on serving size in the pyramid	Fats and oils outside plate with instruction using a small amount.						
Canada	Rainbow (2007)	Four groups	Level 1: Cereals 6–8 servings for adults. Level 2: Fruit and vegetables 7–10 servings for adults.	Fats and oils separate to image with instructions to include a	Qualitative and quantitative information for each group in supportive	Booklet provided		Advice on: varied diet		Eat well and be active today and every day

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micronutrients	Physical activity, alcohol, diet, weight/BMI
			Make at least half of your grain products wholegrain each day. Choose grain products that are lower in fat, sugar or salt. Servings by age/sex.	small amount – 30 to 45 ml unsaturated fat each day.	literature					
UK	Circle (plate)	Five groups	Grains and potatoes (33%). Fruit and vegetables (33%).	Fats and oils are included alongside refined sugar and together comprise 8% of the category		Semi-quantitative information for each group; part of separate text qualitative and quantitative information available in	Salt mentioned in supportive information. Fluid and salt in a separate eight tips list.			Advice on physical activity in a separate eight tips list

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micronutrients	Physical activity, alcohol, diet, weight/BMI
						additional web pages.				
USA	Plate (2010)		Grains 30%. Vegetables 30%. Fruit 20%.	Fats and oils not mentioned.						

Table 49bWHO and country-specific food-based dietary guidelines details

Country	Graphic format	Website
1.WHO/CINDI* *Country-wide integrated non-communicable disease intervention 2000	Pyramid (2000)	http://www.euro.who.int/_data/assets/pdf_file/0010/119926/E70041.pdf http://www.fao.org/ag/humannutrition/nutritioneducation/fbdg/en/
Australia	Plate (2013)	https://www.nhmrc.gov.au/guidelines/publications/n55 Click on link then go to 'Resources suitable for printing' then 'Australian Guide to Healthy Eating - Poster (PDF, 2MB)'
Canada	Rainbow (2007)	http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/index-eng.php http://www.fao.org/ag/humannutrition/nutritioneducation/fbdg/49854/en/can/
UK	Circle (plate)	http://www.nhs.uk/Livewell/Goodfood/Pages/eatwell-plate.aspx
USA	Plate (2010)	http://www.fao.org/ag/humannutrition/nutritioneducation/fbdg/49854/en/usa/

Appendix C

Table 50 Country-specific macronutrient distribution ranges for carbohydrates, proteins and fats

Age group	Percentage of total calories from				Body	Reference
	Carbohydrates	Proteins	Fats			
American						Accessed 27/01/2014
Young children aged 1–3 years	45–65%	5–20%	30–40%	<i>Dietary Guidelines for Americans 2010</i>	U.S. Department of Agriculture. U.S. Department of Health and Human Services	http://www.cnpp.usda.gov/DGAs2010-PolicyDocument.htm
Older children and adolescents aged (4–18 years)	45–65%	10–30%	25–35%	<i>Dietary Guidelines for Americans 2010</i>	<i>Dietary Guidelines for Americans 2010</i>	http://www.cnpp.usda.gov/DGAs2010-PolicyDocument.htm
Adults (19 years and older)	45–65%	10–35%	20–35%	<i>Dietary Guidelines for Americans 2010</i>	<i>Dietary Guidelines for Americans 2010</i>	http://www.cnpp.usda.gov/DGAs2010-PolicyDocument.htm
Canada Percentage of total calories from						Accessed 31/1/2014
1–3 years	45–65%	5–20%	30–40%	<i>Eating Well with Canada's Food Guide –A resource for Educators and Communicators (Page 4)</i>	Health Canada: Federal department. Published by authority of the Minister	http://www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/pubs/res-educat-eng.pdf

Age group	Percentage of total calories from				Body	Reference
	Carbohydrates	Proteins	Fats			
					of Health.	
4–18 years	45–65%	10–30%	25–35%	Canada (Page 4)	Health Canada: Federal department. Published by authority of the Minister of Health.	http://www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/pubs/res-educat-eng.pdf
19 years and over	45–65%	10–35%	20–35 %	Canada (Page 4)	Health Canada: Federal department. Published by authority of the Minister of Health.	http://www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/pubs/res-educat-eng.pdf
	Does not appear to make recommendations.				USA (Harvard)	
Australasia						
Australia	Recommendation not made.					
New Zealand**	Percentage of total energy.					
Young people aged 2–12 years**	Not stated	Not stated	Not stated	Not stated		Healthy eating for children aged 2–12 years August 2010
Young people aged 14–18 years	45–65% of total energy.	15–25%	20–35% of total energy	New Zealand	'Food and Nutrition Guidelines for Healthy Children and	http://www.health.govt.nz/system/files/documents/publications/food-and-nutrition-guidelines-for-healthy-children-and-young-people-p4.pdf August 2012

Age group	Percentage of total calories from				Body	Reference
	Carbohydrates	Proteins	Fats			
					Young People (Aged 2–18 years’): A background paper [Carbohydrates Page 35] Fats page 40] Protein page 46	
Healthy adults aged 18 years and over	50 to 55% of total energy	11–15%	<= 35% of total energy intake	New Zealand	[Carbohydrates pages 15] [Fats page 20 Protein page 11]	http://www.health.govt.nz/system/files/documents/publications/foodandnutritionguidelines-adults.pdf October 2003

***There are limited data on which to base Recommended dietary intake (RDIs), Acceptable intake (AIs) or Upper level of intake (UL for carbohydrate, so these levels have not been set. The acceptable macronutrient distribution range for carbohydrate for young people aged 14 years and over is 45–65% of total energy.*

Table 51 Food-based dietary guidelines and formats and information provided for European countries (including Western Europe, Eastern Europe, Mediterranean countries and Nordic countries), North American countries and Australasian countries

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle	Website
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micro-nutrients	Physical activity, alcohol diet weight/BMI	
1.WHO/CINDI Country-wide, integrated, non-communicable disease intervention 2000	Pyramid (2000)	Four groups. Three levels.	Level 1 or bottom shelf: Cereals, fruit and vegetables (mixed). No instructions on number of servings or serving size.	Level 3: Fats and oils (and other refined sugars)	Green, orange and red background colour helps to indicate relative importance of each group in the model. Green for proceeding. Orange for caution. Red for stop to consider before consuming.			Salt included in separate 12 steps to healthy eating		Advice on, physical activity included in the 12 steps. The graph format contains four active individual figures. Advice on alcohol included in the 12 steps.	http://www.euro.who.int/data/assets/pdf_file/0010/119926/E70041.pdf http://www.fao.org/ag/humannutrition/nutritioneducation/fbdg/en/
2.Albania 2008	Pyramid (2008)	Six groups. Four levels.	Level 1: Cereals. Level 2: Fruit and vegetables. No instructions on number of servings or serving size on the	Level 4 image not clear. No instructions on number of servings or serving size on the pyramid.	Quantitative information for each group						http://www.fao.org/ag/humannutrition/nutritioneducation/fbdg/49851/en/alb/ http://www.fao.org/ag/humannutrition/nutritioneducation/fbdg/49851/en/alb/

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle	Website
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micro-nutrients	Physical activity, alcohol diet weight/BMI	
			pyramid.								tion/18702-0f4d60c439609c4f197e2d4eb9d43d5de.pdf
3.Australia	Pyramid (1981)	Three groups and levels.	<p>Level 1: Cereals, fruit and vegetables (mixed). Eat most of the above</p> <p>No instructions on number of servings or serving size on the pyramid.</p>	<p>Level 3: Fats and oils (and sugar). Eat in small amounts. No instructions on number of servings or serving size on the pyramid.</p>	Qualitative information for each group		Advice on fluids.	Advice on lower salt intake.		<p>Advice on physical activity.</p> <p>Occasional/r estricted foods identified. Advice on food types given in the following phrases: 'Eat in small amount', 'Eat in moderation' 'Eat most'</p>	
4.Australia	Pyramid (1991)	Six groups and levels.	<p>Level 1: Cereals – five plus servings.</p> <p>Level 2: Vegetables – four servings.</p> <p>Level 3: Fruit – three</p>	Not on any shelf.	Quantitative information for each group.	CSIRO 12345+ Food and Nutrition Plan				Occasional/r estricted foods identified. Advice on food types given in the following phrases: 'Eat in small	http://www.csiro.au/proprietaryDocuments/12345_Plan.pdf

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle	Website
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micro-nutrients	Physical activity, alcohol diet weight/BMI	
			servings. No instructions on serving size on the pyramid.							amount', Eat in moderation', 'Eat most'	
5.Australia	Circle (1995/8)	Five groups	Cereals – 33% of total consumption. Vegetables – 25% of consumption. Fruit – 14% of consumption. No instructions on serving size in the pyramid.	Fats and oils (with refined sugars) outside the circle and an instruction choose these sparingly.			Advice on fluids: Drink plenty of water.			Occasional/restricted foods identified.	
6.Australia	Healthy Living Pyramid Nutrition Australia	Three shelves	Level 1: Cereals, vegetables, fruit. Eat most of the above	Level 3: Fats and oils as part of top shelf. Eat in small amounts and use reduced fat spreads.			Water: yes	Advice on salt		Advice on physical activity	http://www.nutritionaustralia.org/national/resource/healthy-living-pyramid

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle	Website
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micro-nutrients	Physical activity, alcohol diet weight/BMI	
7.Australia	Plate (2013)	Five groups	Level 1: Cereals – 33%. Level 2: Vegetables (33%). Level 3: Fruit– 11%. No instructions on serving size in the pyramid.	Fats and oils outside plate with instruction use small amounts							https://www.nhmrc.gov.au/guidelines/publications/n55 Then go to 'Resources suitable for printing'. And then 'Australian Guide to Healthy Eating - Poster (PDF, 2MB)'
8.Austria	Pyramid	Six groups. Six levels.	Level 2: Fruit and vegetables (five portions). Level 3: Cereals (five portions). Instructions in German.	Level 5: Fats and oils. Instructions in German.		Qualitative and or quantitative information for each group not part of the model.	Drinks are sixth group at the base of the pyramid.				
9.Belgium	Pyramid	Eight groups. Six levels.	Level 2: Cereals. Level 3: Fruit (40%) and vegetables	Level 5: Fats and oils. Instructions in French.	Quantitative information for each group; part of the model.	Booklet provides further information on healthy eating.	Drinks are eighth group at the base of the pyramid.			Instructions on physical activity is separate to the graphic.	

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle	Website
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micro-nutrients	Physical activity, alcohol diet weight/BMI	
			(60%). Instructions in French.								
10.Bulgaria	Pyramid (2006)	Six groups. Four levels.	Level 1: Cereals (40% of shelf), fruit and vegetables (60%). No instructions on serving size in the pyramid.	Level 3: Oils only. No instructions on number of servings.	Qualitative information for each group.	Additional leaflets		Advice on: fluids, physical activity.			http://www.fao.org/ag/humannutrition/nutritioneducation/fbdg/49851/en/bgr/ http://www.fao.org/ag/humannutrition/18851-0fe8e3877cda0d67508767a05a1d96bfa.pdf
11a.Canada	Rainbow (1992)	Four groups	Level 1: Cereals (5–12 servings) equivalent of a thin slice of bread. Choose wholegrain and enriched products	No mention	Qualitative and quantitative information for each group in supportive literature	Booklet provided			Advice on: varied diet and amount eaten varies with age and sex.	Advice on physical activity	http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/context/fg_history-histoire_ga-eng.php http://www

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle	Website
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micro-nutrients	Physical activity, alcohol diet weight/BMI	
			more often. Level 2: Fruit and vegetables (5–10 servings).								.hc-sc.gc.ca/fn-an/food-guide-aliment/context/index-eng.php
11b.Canada	Rainbow (2007)	Four groups	Level 1: Cereals (6–8 servings for adults). Level 2: Fruit and vegetables (7–10 servings for adults). Make at least half of your grain products wholegrain each day. Choose grain products that are lower in fat, sugar or salt. Servings by age/sex.	Fats and oils separate to the graphic with instructions to include a small amount (30 to 45 ml) unsaturated fat each day.	Qualitative and quantitative information for each group in supportive literature.	Booklet provided		Advice on: varied diet		Eat well and be active today and every day.	http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/index-eng.php http://www.fao.org/ag/humannutrition/nutritioneducation/fbdg/49854/en/can/

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle	Website
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micro-nutrients	Physical activity, alcohol diet weight/BMI	
12.Croatia	Pyramid	Four groups. Four levels.	Level 1: Cereals. Level 2: Fruit and vegetables. No instructions on number of servings or serving size.	Level 4: Fats and oils (and salt and sugar). No instructions on number of servings or serving size.	Qualitative and quantitative information for each group.			Advice on salt		Advice on physical activity, alcohol, varied diet, weight (BMI)	In http://www.eufic.org/article/en/expid/food-based-dietary-guidelines-in-europe/
13.Czech Republic	Pyramid	Six groups. Four levels.	Level 1: Cereals. Level 2: Fruit (40%) and vegetables (60%). No instructions on number of servings or serving size.	Level 4: Fats and oils (may include sugar). Picture not clear). No instructions on number of servings or serving size.	Qualitative and quantitative information for each group.			No instructions on number of servings		Advice on varied diet, weight	
14.France	Stairs	Six steps	Level 4: Cereal at every meal in accordance with appetite. Level 5: Fruit and	Oils, fats and other unhealthy foodstuffs outside the steps. No instructions on serving			Advice on water	Advice on salt		Advice on physical activity	

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle	Website
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micro-nutrients	Physical activity, alcohol diet weight/BMI	
			vegetables (at least five per day). No instructions on serving size.	size.							
15a and 15b. Finland	Pyramid and plate	Nine groups and six levels in pyramid. Four groups on plate with bread, milk and fruit outside the pyramid and plate. Instructions in Finnish.	In pyramid Level 1: Fruit and vegetables (50% each). Level 2: Cereals (60% wholegrain and 40% rice, pasta or potato).	Level 3: Fats, oils, seeds and nuts (30%) with dairy foods (70%).		Background document					http://www.ravitsemusneuvottelukunta.fi/portal/en/nutrition+recommendations/
16a and 16b. Germany	Three-dimensional pyramid circle	Four groups (pyramid). Seven groups (circle).	Circle 1: Cereals and tubers (30%) all wholegrain. Circle 2: Vegetables (20%). Circle 3: Fruit (17%).	Level 6: Fats and oils (2%). 10–15 g oil. 15–30 g margarine or butter.		Qualitative information for each group; not part of the model.	Drinks constitute one group.				http://www.dge.de/modules.php?name=Content&pa=showpage&pid=40 http://www.fao.org/ag/humannutrition/nutrition

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle	Website
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micro-nutrients	Physical activity, alcohol diet weight/BMI	
											neducation/fbdg/49851/en/deu/
17.Greece	Pyramid	12 groups 11 levels. Also stratified by three time periods: daily, weekly, monthly.	Level 1: Non-refined cereals: *eight portions. Level 2: Fruit *three portions and vegetables – split (in daily strata). *six portions Portion size not easily explained.	Level 3: Oil (in daily strata). No guidance on servings, but appear to be a large amount.	Some qualitative and quantitative information given as part of graphic.		Advice on water intake	Advice on salt intake		Advice on: physical activity, alcohol (wine in moderation)	http://indulgy.com/post/rsdRhXUoP1/greek-food-pyramid
18.Hungary	House	Four groups. Three levels	Level 1: Cereals (33%). Level 2: Fruit and vegetables (33%).	Fats and sugars outside the house. No instructions.		Qualitative and quantitative information given in text separate from graphic.	Water mentioned in supportive text.	Salt mentioned in supportive text.		Advice on exercise, alcohol and food safety, labelling.	ftp://ftp.fao.org/es/esn/nutrition/dietary_guidelines/hun.pdf
19a, b and c. India	Staircase	Four groups and levels.	a and b Level 1: Cereals (30 g) * 9–12 servings. Level 2:	a and b Level 4: Oil (and other foodstuffs) 5 g *4–5 servings	c Level 4: Eat sparingly Level 3: Eat moderately Level 2: Eat			Advice on salt intake		Advice on exercise, smoking.	http://nindia.org/DietaryguidelinesforIndians-Finaldraft.pdf

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle	Website
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micro-nutrients	Physical activity, alcohol diet weight/BMI	
			Fruit (100 g). *1servings and vegetables 100 g *3 servings. Stratified by sex.		liberally. Level 1: Eat adequately.						
20.India	Pyramid	Four groups	Level 1: Cereals (eat adequately). Level 2: Fruit and vegetables (eat liberally).	Level 3: Oil protein and spice. Eat moderately.						Advice on exercise, alcohol and smoking.	http://ninindia.org/DietaryguidelinesforIndians-Finaldraft.pdf
21.Ireland	Pyramid (Department of Health and HSE)	Six groups. Six levels.	Level 1: Cereals and potatoes (6–12 servings depending on age and sex. Serving the size of a slice of bread. Level 2: Fruit and vegetables at least five	5 Fats and oils * 3 teaspoons per day (includes one teaspoon for cooking)	Green, orange and red background colour helps to indicate relative importance of each group in the model. Green for proceeding. Orange for caution. Red for stop to	Extensive and detailed additional information is contained in the booklet in which the pyramid is embedded. Information includes consideration of portion sizes, age-specific	Fluids mentioned in supporting text.	Advice on salt intake mentioned in additional tips.	Folic acid mentioned in supporting text.	Advice on exercise, alcohol, diet and weight. Advice on sugars and sugary drinks.	https://www.healthpromotion.ie/hp-files/docs/HPM00796.pdf

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle	Website
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micro-nutrients	Physical activity, alcohol diet weight/BMI	
			per day, and more if active,		consider before consuming.	serving amounts.					
22.Ireland	Pyramid (Health Service Executive)	Six groups. Six levels. (1–4 daily and 5–6 are for occasional consumption.)	Level 1: Cereals (six or more per day.) Serving the size of a slice of bread. Level 2: Fruit and vegetables (five or more per day of medium-sized piece of fruit.)	Level 5: Fats and oils. Use as little as possible and choose reduced-fat or low-fat spread and vegetable oils. Individual portion pack for 2–3 slices of bread. One teaspoon per person when cooking.	Version for adults and children aged over five years provides qualitative and quantitative information for each group.	Semi-quantitative information for each group; part of separate text qualitative and quantitative information available in additional web pages. Specific portions/measures for all foods.	Fluids mentioned in supporting text.			Advice on alcohol, diet. Advice on sugars and sugary drinks.	https://www.healthpromotion.ie/hp-files/docs/HPM00829.pdf http://www.fao.org/ag/humannutrition/nutritioneducation/fbdg/49851/en/irl/
23.Ireland	Table (Food Safety Authority of Ireland) by age-sex	Six groups.	Top down. Level 1: Cereals (3–7 servings for adults.) Level 2: Fruit and vegetables (5–7 servings). Wholemeal	Level 5: Fats and oils, margarines and butter. Use a reduced-fat spread sparingly. Choose one that is monounsaturated	Version for adults and children aged over five years provides qualitative and quantitative information for					Poster-like presentation of findings. Plus scientific publication.	https://www.fsai.ie/ http://www.fsai.ie/resources_publications.html http://www.fsai.ie/resources_publications.html

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle	Website
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micro-nutrients	Physical activity, alcohol diet weight/BMI	
			and wholegrain provide the best energy.	urated or polyunsaturated. Use vegetable oils sparingly.	identified age groups, stratified by sex.						ations.html
24.Japanese	Food guide. Spinning top.	Five groups. Four levels.	Level 1: Grains (5–7 servings). Level 2: Fruit and vegetables (5–6 servings).	Is not mentioned.			Advice on fluids.			Advice on physical activity.	http://www.mhlw.go.jp/bunya/kenkou/pdf/eiyou-syokujii5.pdf http://www.mhlw.go.jp/L http://www.maff.go.jp/j/balance_guide/
25.Latvia	Food Guide Pyramid (2002)	Four groups (plus water at the bottom of the pyramid). Four levels.	Level 1: Cereals (50% of intake). Level 2: Fruit and vegetables (30% of intake).	Level 4: Fats and oils (and other foodstuffs).	Percentages on the side of the pyramid provide information on how large a part of your daily intake this food group	Qualitative and quantitative information for each group; not part of the model.	Advice on fluids.	Advice on salt.		Advice on physical activity, alcohol, weight (BMI).	http://www.vvm.gov.lv/en/ http://www.fao.org/ag/humannutrition/nutritioneducation/fbdg/49851/en/lva/

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle	Website
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micro-nutrients	Physical activity, alcohol diet weight/BMI	
					should constitute.						
26.Netherlands	Wheel	Five groups.	Level 1: Fruit and vegetables (30%). Level 2: Cereals (30%). Instructions in Dutch.	Level 4: Fats and oils (7%).							http://nl.wikipedia.org/wiki/Schijf_van_vijf http://www.fao.org/ag/humannutrition/nutritioneducation/fbdg/49851/en/nld/
27.Philippines	Pyramid (2008). Age groups, pregnancy and lactation.	Six groups and five levels.	Level 2: Grains and potatoes (5–8 servings for adults). Level 2: Fruit (50%) and vegetables (50%) – three servings of each.	Level 5: Fats and oils with sugars and 6–8 teaspoons per day for adults.			Group 1		Advice on micro nutrient supplements.	Advice on physical activity	http://www.fnri.dost.gov.ph/index.php?option=com_content&task=view&id=1275&Itemid=162
28.Portugal	Circle (2003)	Seven groups.	Level 1: Fruit (20%) and vegetables (23%). Level	Level 5: Fats and oils (2%).			Water at centre of circle				http://www.fao.org/ag/humannutrition/nutritioneducation/

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle	Website
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micro-nutrients	Physical activity, alcohol diet weight/BMI	
			2: Cereals (28%).								fbdg/49851/en/prt/
29.Poland (2009)	Pyramid	Five groups and levels.	Level 1: Eat at least five portions of cereal products every day. Level 2: Fruit and vegetables. Eat four portions of vegetables and three portions of fruit.	No oils in pyramid. Vegetable oils and soft margarines are recommended. Limit intake of fats, particularly of animal fats.		10 principles of healthy nutrition in some formats.	Water represented outside the pyramid in some formats.		Salt included in the 10 principles.	Advice on alcohol mentioned in the 10 principles.	http://www.fao.org/ag/humannutrition/nutritioneducation/fbdg/49851/en/pol/
30.Spain	Mediterranean diet pyramid –Spain (2004)	Six groups.	Level 1: Grains and potatoes. Level 2: Fruit, vegetables and oil. Eat daily.	Level 2: Oil. Eat daily. Level 6: Butter. Consume occasionally.	Eat for pleasure and health.		Advice on water.			Advice on physical activity.	http://dieta.mediterranea.com/en/mediterranean-diet/food-pyramid/
31.Switzerland	Pyramid	Six groups. Six levels.	Level 2: Fruit and vegetables. Five portions per day of different colours.	Level 5: Fats and oils (and other foodstuffs). Oils and nuts in small quantities daily.		Qualitative and qualitative information for each group; part of separate text.	Fluid is sixth group at the base of the pyramid.			Advice on physical activity in supportive text. Alcohol in supportive text.	http://www.sgsn.ch/media/library/2013/03/_sge_merkblaetter_pyr amid_basic_

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle	Website
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micro-nutrients	Physical activity, alcohol diet weight/BMI	
			Level 3: Cereals. Three portions per day. Grains should preferably be wholegrain.	Butter/margarine sparingly.							e.pdf
32.UK	Circle (plate)	Five groups	Grains and potatoes (33%). Fruit and vegetables (33%).	Fats and oils are part of refined sugar and together comprise 8% of the total allocation with in the level.		Semi-quantitative information for each group; part of separate text. Qualitative and quantitative information available in additional web pages.	Salt mentioned in supportive information. Fluid and salt in a separate eight tips list.			Advice on physical activity in a separate eight tips list.	http://www.nhs.uk/LiveWell/GoodFood/Pages/eatwell-plate.aspx
33.USA	Pyramid (1992)	Six groups. Four levels.	Level 1: Grains (6–11 servings). Level 2: Fruit (45%, 2–4 servings) and vegetables (55%, 3–5	Level 4: Fats and oils and refined sugars. However, they are distributed on all levels. Use sparingly.							http://en.wikipedia.org/wiki/Food_guide_pyramid

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle	Website
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micro-nutrients	Physical activity, alcohol diet weight/BMI	
			servings).								
34.USA	Pyramid (2005)	Six groups	Level 1: Grains (6 oz. per day of which 3 oz. wholegrain). Level 2: Vegetables (eat 2.5 cups per day.) Level 3: Fruit (eat two cups per day.)	Level 4: Oils (not mentioned) but visual representation on pyramid. Most of oils requirements are obtained from fish, nuts and vegetable oils. Limit use of butter and margarine. Keep saturated fat and trans fat low.		Vertical pyramid				Introduced a web-based programme for personal diet planning.	http://en.wikipedia.org/wiki/MyPyramid
35.USA	Plate (2010)		Grains (30%). Vegetables (30%). Fruit (20%).	Fats and oils not mentioned.							http://www.fao.org/ag/humannutrition/nutritioneducation/fbdg/49854/en/usa/

Country	Graphic format	No of food groups	Carbohydrates, cereals, fruit and vegetables	Fats and oils	Supportive information	Supportive information	Additional intake	Additional intake	Additional intake	Lifestyle	Website
			Level	Level	In model	In accompanying literature	Fluids	Salt	Specific micro-nutrients	Physical activity, alcohol diet weight/BMI	
36.USA - Harvard Mediterranean diet 'Oldways',	Pyramid (1994) and updated in 2008.	Eight food groups. Five levels.	Level 2: Grains (45%), fruit and vegetables (45%) and oil (10%). Wholegrain recommended.	Level 2: Grains (45%), fruit and vegetables (45%) and oil (10%). Level 5: Fats (butter, red meat, refined grain, potatoes, sugars sweets and salt.) Use sparingly.					Extra Vitamin D	Exercise Weight control Alcohol optional and in moderation	http://ajcn.nutrition.org/content/61/6/1402S.full.pdf
37.USA – Harvard	Plate (2013)		Whole grains (50%). Vegetables (excluding potatoes) (30%). Fruit (20%).	Healthy oils are outside plate. (Use for cooking, salads and at the table.) Limit butter and avoid trans fats.			Advice water intake.			Advice physical activity. Advised varied diet.	http://www.hsph.harvard.edu/nutritionsource/healthy-eating-plate-vs-usda-myplate/

Appendix D Country-specific dietary recommendations

D 1. Australia

Table 52 Weekly servings or amounts required in the Australian Omnivore Foundation Diet for males and females, designed to attain recommended dietary intake (RDI) for energy needs of the smallest (160 cm for males and 150 cm for females) and very sedentary lifestyle (physical activity level 1.4) in that group

									Maximum and minimum values and difference in values between the age ranges 70 plus years minus 19–30 years					
	Males 160 cm very sedentary PAL 1.4				Females 150 cm very sedentary PAL 1.4				Min	Max	Range	Min	Max	Range
	19–30	31–50	51–70	70+ yrs	19–30	31–50	51–70	70+ yrs	Min	Max	Range	Min	Max	Range
Wholegrain or higher-fibre cereals/grains (equivalent: 40 g)	28	28	28	21	28	28	20	15	21	28	-7	15	28	-13
Refined or lower-fibre cereals/grains (equivalent: 40 g)	14	14	14	10	14	14	8	6	10	14	-4	6	14	-12
Starchy vegetables (75 g) (Potato, sweet potato, sweetcorn, cassava)	7	7	7	5	5	5	5	3	5	7	-2	3	5	-2
Green and brassica vegetables (75 g)	7	7	7	7	7	7	7	7	7	7	0	7	7	0
Oranges vegetables (75	7	7	7	7	7	7	7	7	7	7	0	7	7	0

									Maximum and minimum values and difference in values between the age ranges 70 plus years minus 19–30 years					
	Males 160 cm very sedentary PAL 1.4				Females 150 cm very sedentary PAL 1.4				Min	Max	Range	Min	Max	Range
	19–30	31–50	51–70	70+ yrs	19–30	31–50	51–70	70+ yrs	Min	Max	Range	Min	Max	Range
g)														
Legumes (75 g)	7	7	2	2	2	2	3	3	2	7	-5	3	2	-1
Other vegetables (75 g)	14	14	14	14	14	14	14	14	14	14	0	14	14	0
Fruit (75 g)	14	14	14	14	14	14	14	14	14	14	0	14	14	0
Polyunsaturated margarine (10 g)	28	28	28	14	14	14	14	14	14	28	-14	14	14	0
Dairy foods (milk, yogurt, cheese) (equivalent: 250 g)	17	17	17	24	17	17	28	28	17	24	7	17	28	11
Nuts/seeds (75 g)	7	7	4	4	2	2	3	3	4	7	-3	2	3	-1
Meats (beef, lamb, veal, pork) (65 g)	7	7	7	7	7	7	3	3	7	7	0	3	7	-4
Meats and alternatives minus red meats (equivalent: 65 g)	7	7	7	7	7	7	7	7	7	7	0	7	7	0

Table 53 Weekly servings or amounts required in the Australian Omnivore Foundation Diet for boys and girls, designed to attain recommended dietary intake (RDI) for each identified age group for energy needs of the youngest and very sedentary lifestyle (physical activity level 1.4) children in that group

									Maximum and minimum values and difference in values between the age ranges (14–18 years) (4–8 years). Higher age range minus lower age range					
	Boys				Girls				Min	Max	Range	Min	Max	Range
	4–8	9–11	12–13	14–18	4–8	9–11	12–13	14–18	Boys	Boys	Boys	Girls	Girls	Girls
Wholegrain or higher-fibre cereals/grains (equivalent: 40 g)	19	23	28	32	19	19	24	35	19	32	13	19	35	16
Refined or lower-fibre cereals/grains (equivalent: 40 g)	9	12	14	17	9	9	11	14	9	17	8	9	14	5
Starchy vegetables (75 g) (potato, sweet potato, sweetcorn, cassava)	3.5	5	7	7	3.5	5	5	5	3.5	7	3.5	3.5	5	1.5
Green and brassica vegetables (75 g)	7	7	7	7	7	7	7	7	7	7	0	7	7	0
Orange vegetables (75 g)	7	7	7	7	7	7	7	7	7	7	0	7	7	0
Legumes (75 g)	2	2	2	2	2	2	2	2	2	2	0	2	2	0
Other vegetables (75 g)	10.5	14	14	14	10.5	14	14	14	10.5	14	3.5	10.5	14	3.5
Nuts/seeds (75 g)	0	2	2	4	0	2	2	2	0	4	4	0	2	2
Fruit (75 g)	10.5	14	14	14	10.5	14	14	14	10.5	14	3.5	10.5	14	3.5
Dairy foods (milk, yogurt, cheese) (equivalent: 250 g)	14	17	25	25	11.5	21	24.5	24.5	14	25	11	11.5	24.5	13

									Maximun and minimum values and difference in values between the age ranges (14–18 years) (4–8 years). Higher age range minus lower age range					
Polyunsaturated margarine (10 g)	5	7	10.5	14	5	7	7	14	5	14	9	5	14	9
Meats and alternatives minus red meat (equivalent: 65 g)	5.5	7	7	7	5.5	7	7	7	5.5	7	1.5	5.5	7	1.5
Meats (beef, lamb, veal, pork) (65 g)	5	7	7	7	5	7	7	7	5	7	2	5	7	2

Table 54 Weekly servings or amounts in the Australian Omnivore Total Diet of the named food groups for six derived total diets in persons aged 30–51 years with a physical activity level of 1.7, with an average height of 175 cm (males) or 165 cm (females) and daily dietary intake of 2,796 kcal (males) and 2,342 kcal (females), and differences in serving amounts between the six total diets

	Age range 30–51 years																					
	Total diets Physical activity level 1.7												Difference between identified total diets									
	Males (average height 175 cm)						Females (average height 165 cm)															
	above 11,700 kJ (2,796 kcal) Servings or amount per week						above 9,800 kJ (2,342 kcal) Servings or amount per week						Males					Females				
	1	2	3	4	5	6	1	2	3	4	5	6	2-1	3-1	4-1	5-1	6-1	2-1	3-1	4-1	5-1	6-1
Cereals/grains (40 g bread equivalent)	56	59	49	53	49	56	45	42	42	45	59	45	3	-7	-3	-7	0	3	3	0	14	0
Total vegetables (75 g equivalent)	56	56	49	56	42	63	35	49	35	56	35	56	0	-7	0	-14	7	14	0	21	0	21
Fruit (150 g)	14	14	21	21	14	28	14	21	21	14	14	17	0	7	7	0	14	7	7	0	0	3
Unsaturated oils and spreads (g)	280	280	280	280	280	280	280	280	280	280	140	280	0	0	0	0	0	0	0	0	140	0
Dairy foods (250 g milk equivalent)	14	24	17	17	24	17	21	21	21	21	20	21	10	3	3	10	3	0	0	0	-1	0
Nuts and seeds (30 g equivalent)	7	14	14	7	7	7	4	4	4	3	4	4	7	7	0	0	0	0	0	1	0	0

	Age range 30–51 years																					
	Total diets Physical activity level 1.7												Difference between identified total diets									
	Males (average height 175 cm)						Females (average height 165 cm)															
	above 11,700 kJ (2,796 kcal) Servings or amount per week						above 9,800 kJ (2,342 kcal) Servings or amount per week						Males					Females				
Total meats and alternatives (g)	1155	1155	1155	1155	1155	1155	1155	1155	1155	1155	1155	1155	0	0	0	0	0	0	0	0	0	
Discretionary choices (143 kcal equivalent)	17	7	10.5	14	14	7	7	3.5	7	7	3.5	0	-10	-6.5	-3	-10	-3.5	0	0	-3.5	-7	

D 2. Canada

Table 55 Generation of sedentary lifestyle diets from food groups, Canada

The seven-step food-based dietary guidelines development framework – as applied in Canada

1. **The diet-health relationship**
 - a) Findings from the 1991 *Food Guide*.
 - b) The Dietary Reference Intake reports from the Institute of Medicine for: thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, pantothenic acid, biotin, and choline; vitamin C, vitamin E, selenium, and carotenoids; vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc; energy, carbohydrate, fibre, fat, fatty acids, cholesterol, protein, and amino acids (macronutrients); water, potassium, sodium, chloride and sulphate.
 - c) Whole grains *and* reduced risk of CVD
 - d) Milk products *and* reduced risk of osteoporosis
 - e) Fish, particular fatty fish, *and* reduced risk of CVD
2. **Country-specific diet-related health problems**
Analyses of these data are not reported in the examined publications.
3. **Nutrients of public health importance**
The micronutrients identified as of public health importance were: folate, thiamine, vitamin A, B6, B12, C, zine and iron; an AI for calcium and linoleic acid. Alpha-linoleic acid, potassium, sodium, fibre and vitamin D AND $\geq 80\%$ of diets with macronutrients of carbohydrate, fat and protein with lower and upper bounds of the Acceptable Macronutrient Distribution Ranges (AMDRs)
4. **Core and composite food groups**
The final composite food groups used for modelling were:
 1. Vegetables and fruit
 - i. Vegetables
 1. Dark green vegetables
 2. Orange vegetables
 3. Higher-fat potatoes
 4. Lower-fat potatoes
 5. Other vegetables
 - ii. Fruit and juices
 1. Fruit
 2. Juices
 2. Grain products
 - i. Wholegrain products
 1. Higher-fat whole grains
 2. Lower-fat whole grains
 - ii. Non-wholegrain products
 1. Higher-fat non-whole grains
 2. Lower-fat non-whole grains
 3. Milk and alternatives
 - i. Fluid milk and fortified plant-based beverages
 1. Higher-fat fluid
 2. Lower-fat fluid
 - ii. Milk products
 1. Higher-fat other
 2. Lower-fat other
 4. Meats and alternatives
 - i. Fresh and processed meat
 1. Higher-fat fresh meat
 2. Lower-fat fresh meat
 3. Processed meat
 - ii. Fresh and processed fish and shellfish
 - iii. Eggs
 - iv. Pulses/alternatives (legumes, peanuts, tofu, and meat analogues)
 - v. Nuts and nut products (excluded peanut; included sunflower and other seeds)
5. Food outside the four food groups

The seven-step food-based dietary guidelines development framework – as applied in Canada

- i. Fats
 - 1. Saturated fats (butter, shortening, cream cheese, stick margarine, whipping cream, etc.)
 - 2. Unsaturated fats (tub margarine, vegetable oil, salad dressing, mayonnaise, etc.)
- ii. Confectioneries and sugars (sugar, frozen desserts, pies, candies, chocolate-coated granola bars, Danish pastries, etc.)
- iii. Non-alcoholic beverages
 - 1. Higher calorie (carbonated beverages, fruit drinks, hot chocolate made with water, etc.)
 - 2. Lower calorie (coffee, tea, artificially sweetened drinks, etc.)
- iv. Salty snack foods (potatoes chips, tortilla chips, popcorn, pretzels etc.)
- v. Alcoholic beverages
- vi. Other/miscellaneous condiments, spices, etc.

5. Food composition patterns

National food consumption patterns and nutrition and physical activity survey databases

- a. Statistics Canada's 2001 Food Expenditure Survey (FoodEx)
- b. The British Columbia Federal-Provincial dataset
- c. The Manitoba Federal-Provincial dataset
- d. The Ontario surveys for adult data
- e. The Quebec youth survey for children's data. [No national datasets were available.]

6. Testing and optimising

A two-step modelling process was adopted. In the first step, composite foods from major or sub-major food groups were created and modelled to meet US/Canadian RDAs (RDI) within the AMDRs. In the second step, models were tested with 'real' food. Up to 500 age and sex-specific simulated diets were created using individual foods before satisfactory models were achieved. For example, if the food intake pattern created in step one recommended three servings of fruit, four simulated diets may include the following combinations: one apple, one banana, one pear; or one plum, one orange, one banana; or one plum, one orange, one banana; or three apples; or one apple, two bananas from nutrition surveys and evaluated for nutrient requirements.

7. Graphic representation

The image is presented in the main body of the text.³⁴

Table 56 Eating Well with Canada's Food Guide (2007): Number of food guide servings for males and females, by age and by sedentary activity levels

									Maximum and minimum values, and difference in values between the age ranges (14–18 years) (4–8 years). Higher age range minus lower age range					
		Boys and girls	Boys	Girls	Males	Females	Males	Females						
	4–8	9–13	14–18	14–18	19–50	19–50	51+	51+	Min	Max	Range	Min	Max	Range
Grain products (equivalent: 35 g bread)	4	6	7	6	8	6-7	7	6	4	7	3	4	7	3
Vegetables and fruit (125 mls, half a cup)	5	6	8	7	8-10	7-8	7	7	5	10	5	5	8	3
Unsaturated fats* (g)	30	30	45	30	45	30	45	30						
Milk and alternatives (equivalent: 250 ml milk)	2	4	4	4	2	2	3	3	1	4	3	2	4	2
Meats and alternatives (equivalent 75 g meat)	1	2	3	2	3	2	3	2	1	3	2	1	2	1

*More specifically unsaturated fats and oils

Table 57 Canada

Food Group	Statement
Vegetables and fruit	Eat at least one dark green vegetable and one orange vegetable each day.
	Choose vegetables and fruit prepared with little or no added fat, sugar or salt.
	Have vegetables and fruit more often than juice.
Grain products	Make at least half of your grain products wholegrain each day.
	Choose grain products that are lower in fat, sugar or salt.
Milk and alternatives	Drink skim, 1% or 2%, milk each day.
	Select lower-fat milk alternatives
Meats and alternatives	Have meat alternatives such as beans, lentils and tofu often.
	Eat at least two <i>Food Guide</i> servings of fish each week.
	Select lean meats and alternatives prepared with little or no added fat or salt.
Oils and fats	Include a small amount i.e., 30–45 ml (2–3 tablespoons) unsaturated fat each day. This includes oils used for cooking, salad dressing, margarine and mayonnaise.

D 3. Sweden

Table 58 Generation of sedentary lifestyle diets from food groups Sweden

The seven-step food-based dietary guidelines development framework – as applied in Sweden

1. The diet-health relationship

Detailed background on evidence informing the modelling process was not available in English. The starting point for this work was the Swedish Nutrition Recommendations (SNR) (1997). Food-based recommendations were said to be 'conversions' of nutrition recommendations, which take into account the dietary habits and dietary patterns that apply for the actual population or group. The concept includes advice on foods, quantities, frequencies and eating habits. Swedish Nutrition Recommendations Objectified (SNO) (in terms foods and menus) is the conversion of the recommendations into actual values of food consumption.

2. Country-specific diet-related health problems

Analyses of these data are not reported in the examined publications.

3. Nutrients of public health importance

The micronutrients, and their ranges, identified as of public health importance were: (Vitamins) retinol, µg – 1150 – 1330, β-carotene, µg – 2600/ 2810, vitamin A, RE 1620/1820, vitamin D, µg 7/9, vitamin E (α-tocopherol), mg 11/13, vitamin C, mg 155/191, thiamin, mg 1.7/2.2, riboflavin, mg 2.0/2.5, niacin, NE 37/47, vitamin B6, mg 2.4/3.1, vitamin B12, µg 5.9/7.4, folate, µg 370/460. (Minerals) calcium, mg 910/1140, phosphorus, mg 1490/1910, sodium, mg 2000/2510, potassium, mg 3900/4800, magnesium, mg 360/ 460, iron, mg 14/17, zinc, mg 12/15, selenium, µg 43/55

4. Core and composite food groups

The final composite food groups used for modelling were:

- i. Fruit and vegetables total:
 - a. Vegetables: lettuce, tomato, pepper, onion etc. carrot, broccoli, white cabbage etc.
 - b. Fruit and berries. Fruit juice
- ii. Pulses, dried
- iii. Bread: total white bread, refined rye wholemeal bread, crisp bread
- iv. Breakfast cereals, porridge
- v. Flour
- vi. Potatoes
- vii. Rice, couscous
- viii. Pasta
- ix. Meat and poultry: lean types, fatty types
- x. Sausage
- xi. Liver pâté
- xii. Blood-based foods
- xiii. Fish and seafood
- xiv. Eggs
- xv. Milk and yogurt: fat 0.5%; fat 1.5%; fat 3%
- xvi. Cheese: fat ≤ 17%
- xvii. Cottage cheese, whey cheese
- xviii. Cream
- xix. Total fat (margarine, oil): fat 30%; fat 40%; fat 60%; fat 80% (not butter). Margarine spread on bread
- xx. Leeway foods: savoury snacks, buns, pastries, cakes, ice cream, desserts, sweets, jam, fizzy drinks, sugar

8. Food composition patterns

A range of foodstuffs, mainly raw ingredients, were chosen from the Swedish food database PC-Kost, the national dietary surveys HULK (1994) and Riksmaten (1997–98). The chosen foodstuffs had to be representative of their food group.

9. Testing and optimising

Swedish portion sizes were chosen for each food according to Vikttabeller (1999) and consumption frequencies, with an occurrence rate of at least once a month. Portion sizes and frequencies were then adjusted and converted to grams per day. When energy and nutrients were finally added up for all foods, they met the specified energy levels and nutrition recommendations. In total, 71 foodstuffs are included in the basic material. On the basis of this, a food list was compiled with amounts to be consumed per day and per week. To test whether it was possible to prepare menus based on the list, KF Test Kitchen was given the task of drawing up a four-week menu. Omissions in the list were brought to light and adjustments made. In this way, the final food list was developed. The exchangeability of different food groups was tested, as was the range of freedom within the groups. The menus were refined by the National Food Administration and were eventually tested on subjects.

The seven-step food-based dietary guidelines development framework – as applied in Sweden

10. Graphic representation

The image is presented in the main body of the text.³⁵

Table 59 Amount of food (raw produce) per day and per week for a woman and a man with low physical activity in Sweden, in the age range 19–60 years

	Age range 19–60 years					
	Diets Amounts of food (raw produce)				Difference: males minus females	
	Males (low physical activity)		Females (low physical activity)			
	above 11.5 MJ(2,747 kcal) Servings or amount per week		above 9.1 MJ (2,174 kcal) Servings or amount per week		Per day	Per week
	Per day	Per week	Per day	Per week		
Grain products						
Pulses, dried (g)	13	91	10	70	-3	-21
Bread, total (g)	205	1,435	165	1,155	-40	-280
White bread, refined rye	109	763	90	630	-19	-133
Wholemeal bread, crispbread	96	672	75	525	-21	-147
Breakfast cereals, porridge	43	301	29	203	-14	-98
Flour	9	63	7	49	-2	-14
Potatoes	210	1,470	175	1,225	-35	-245
Rice, couscous	25	175	18	126	-7	-49
Pasta	43	301	36	252	-7	-49
Vegetables and fruit (total)	673	4,711	550	3,850	-123	-861
Vegetables	309	2,163	250	1,750	-59	-413
Lettuce, tomato, pepper, onion etc.	180	1260	125	875	-45	-385
Carrot, broccoli, white cabbage etc.	130	910	125	875	-5	-35
Fruit and berries	250	1,750	214	1,498	-36	-252
Fruit juice	114	798	86	602	-28	-196
Fats and oils						
Total fat (margarine, oil)	47	329	38	266	-9	-63
Margarine spread on bread	25	175	19	133	-6	-42
Milk and alternatives						
Milk and yogurt (males)	375	2625	320	2240	-50	-385

	Age range 19–60 years					
	Diets Amounts of food (raw produce)				Difference: males minus females	
	Males (low physical activity)		Females (low physical activity)			
	above 11.5 MJ(2,747 kcal) Servings or amount per week		above 9.1 MJ (2,174 kcal) Servings or amount per week		Per day	Per week
Fat 0.5% (males)	210	1,470	190	1,330	-20	-140
Fat 1.5% (males)	148	1036	118	826	-20	-210
Fat 3% (males)	17	119	13	91	-4	-28
Cheese (males)	22	154	20	140	-2	-14
Fat <17% (males)	15	105	14	98	-1	-7
Cottage cheese, whey cheese (males)	5	35	5	35	0	0
Cream (males)	17	119	13	91	-4	-28
Meats and alternatives						
Meat and poultry (males)	120	840	95	665	-25	-175
Lean types (males)	51	357	41	287	-10	-70
Fatty types (males)	69	483	54	378	-15	-105
Sausage (males)	18	126	17	98	-1	-28
Liver pâté (males)	15	105	15	105	0	0
Blood-based foods (males)	8	56	5	35	-3	-14
Fish and seafood (males)	64	448	45	315	-19	-133
Eggs (males)	26	182	21	147	-5	-35

D 4. United States of America

Table 60 Generation of diets from food groups USA, U.S. Department of Agriculture (USDA)

The seven-step food-based dietary guidelines development framework – as applied in the United States of America

1. The diet-health relationship (issues examined)

Adequacy of the USDA food patterns

How well do the USDA food patterns, using updated food intake and nutrient data, meet IOM and potential DG 2010 nutrient recommendations?

Realigning vegetable subgroups

What revisions to the vegetable subgroups may help to highlight vegetables of importance, and allow recommendations for intake levels that are achievable, without compromising the nutrient adequacy of the patterns?

Vegetarian food patterns

How well do plant-based or vegetarian food patterns, adapted from the USDA food patterns, meet IOM and potential DG 2010 nutrient recommendations?

Starchy vegetables

How do the nutrients provided by the starchy vegetables subgroup compare with those provided by grains and those provided by other vegetable subgroups? How would nutrient adequacy of the patterns be affected by considering starchy vegetables as a replacement for some grains rather than as a vegetable subgroup?

“Typical choices” food patterns

What is the impact on caloric and nutrient intake if the USDA food patterns are followed, but typical rather than nutrient-dense food choices are made?

Milk group and alternatives

What is the impact on nutrient adequacy (1) if no milk or milk products were consumed, (2) if calcium were obtained from non-dairy sources or fortified foods, and (3) if more fluid milk and less cheese were consumed?

Replacing all non-whole grains with whole grains

What is the impact on intake of folate and other nutrients if all recommended grains amounts are selected as whole grains rather than half whole and half non-whole grains?

Cholesterol

What is the impact on food choices and overall nutrient adequacy of limiting cholesterol to less than 200 mg per day?

Reducing cholesterol-raising fatty acids

What is the impact on food choices and overall nutrient adequacy of limiting cholesterol-raising (CR) fatty acids to less than 7% of total calories and to less than 5% of total calories, with CR fatty acids operationalised as total saturated fatty acids minus stearic acid?

Seafood

What is the impact on nutrient adequacy of increasing seafood in the USDA food patterns to (1) 4 oz. per week of seafood high in n-3 fatty acids, (2) 8 oz. per week of seafood in proportions currently consumed, and (3) 12 oz. per week of seafood low in n-3 fatty acids?

Sodium

What would the sodium levels of the USDA food patterns be in (1) using current patterns, (2) using “typical choices” patterns, and (3) using only low-sodium and no-salt-added foods?

Potassium

What are the potassium levels in the USDA food patterns, when compared to current consumptions and dietary approach to stop hypertension (DASH) diet levels, in absolute amounts, adjusted for energy intake, and as a ratio of sodium to potassium? How would potassium levels of the USDA food pattern change if current levels of coffee and tea intake were included?⁵⁰

2. Country-specific diet-related health problems

Analyses of these data are not reported in the examined publications.

3. Nutrients of public health importance

The micronutrients identified as of public health importance were: **vitamins** A, E, D, C, thiamin, riboflavin, niacin, vitamin B6,

The seven-step food-based dietary guidelines development framework – as applied in the United States of America

vitamin B12, choline, vitamin K, total folate; **minerals** calcium, iron, magnesium, phosphorus, potassium, sodium, zinc, copper, selenium; **macronutrients** protein, total lipid (fat), carbohydrate, fibre, total dietary water; **fats and fatty acids** cholesterol, saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, 18:0 stearic acid, 18:2 linoleic acid, 18:3 linolenic acid; **not modelled for** trans fatty acids, manganese, fluoride, and some individual fatty acids.

4. Core and composite food groups

Food groups used for modelling were:

1. Vegetables and fruit
 - i. Vegetables
 - a. Dark green vegetables
 - b. Red and orange vegetables
 - c. White potatoes, corn, green peas
 - d. Beans and peas
 - e. Other vegetables – iceberg lettuce, green beans, onions
 - ii. Fruit and juices
 - a. Fruit
 - b. Juices
2. Grain products
 - i. Wholegrain products
 - a. All whole grains
 - b. Enriched whole grains
3. Milk and milk products
 - i. Fluid milk and fortified plant-based beverages
 - a. Higher-fat fluid
 - b. Lower-fat fluid
4. Protein foods
 - i. All meat
 - ii. Poultry
 - iii. Seafood
 - iv. Eggs
 - v. Nuts, seeds and processed soya products
 - vi. Beans and peas (Beans and peas are considered part of this group, and as part of the vegetables group, but should be counted in one group only)
5. Food outside the four food groups
 - i. Oils
 - ii. Solid fats
 - iii. Added sugars
 - iv. Alcoholic

In the USDA food patterns, some of the calories assigned to limits for solid fats and added sugars may be used for alcohol consumption instead.

5. Food composition patterns

National Health and Nutrition Examination Survey (NHANES) analyses conducted by the National Cancer Institute (NCI)

6. Testing and optimising

1. Assigned all foods reported consumed from the NHANES 2003-2004 to appropriate item clusters.
2. Selected an “ideal” (in nutrient-dense form) representative food for each item cluster.
3. Calculated nutrient profiles for each food group or subgroup using the nutrient data for “ideal” representative foods and the proportional consumption of each item cluster from the group composite.
4. Modified recommended weekly intake amounts for vegetable subgroups from those in the 2005 Dietary Guidelines to accommodate modifications to vegetable subgroups.
5. Calculated calories and nutrients provided by each pattern from nutrient profile and recommended intake data.
6. Identified nutritional goals that were met or not met for appropriate age-sex groups at each calorie level.

7. Graphic representation

The image is presented in the main body of the text.³⁴

Agricultural Research Service (ARS). Nutrient intakes from food: mean amounts consumed per individual, one day, 2005–2006. Food Surveys Research Group, ARS, U.S. Department of Agriculture. www.ars.usda.gov/ba/bhnrc/fsrg.

Table 61 US daily nutritional goals for age-sex groups, based on dietary reference intakes and dietary guidelines recommendations

													Maximum and minimum values and difference in values between the age ranges (51+ years) (4–8 years). Higher age range minus lower age range					
	Boys	Girls	Boys	Girls	Boys	Girls	Male s	Femal es	Male s	Femal es	Male s	Femal es	Males			Females		
Age	4 - 8	4 - 8	9-13	9-13	14-18	14-18	19-30	19-30	31-50	31-50	51+	51+	Min	Max	Rang e	Min	Max	Rang e
Carbohydrat es RDA	130	130	130	130	130	130	130	130	130	130	130	130	130	130	0	130	130	0
Total fibre (g) IOM	20	17	25	22	31	25	34	28	25	31	28	22	20	34	14	17	31	24
Protein (g) RDA	19	19	34	34	52	46	56	46	56	46	56	46	19	56	37	19	46	27
Total fat (% of calories)	25-35	25-35	25-35	25-35	25-35	25-35	20-35	20-35	20-35	20-35	20-35	20-35	20-35	25-35	-	25-30	20-35	-
Saturated fat (% of calories)	<10 %	<10 %	<10 %	<10 %	<10 %	<10 %	<10 %	<10 %	<10 %	<10 %	<10 %	<10 %	<10 %	<10 %	0	<10 %	<10 %	0

RDA: Recommended dietary allowance

IOM: Institute of Medicine¹⁶

**Table 62 USDA recommended average daily intake amounts at all calorie levels for each food group or subgroup.
Recommended intakes from vegetable and protein foods subgroups are per week.**

Recommended in take												
Calorie level of pattern ^c	1,000	1,200	1,400	1,600	1,800	2,000	2,200	2,400	2,600	2,800	3,000	3,200
Grains^e	3 oz-eq	4 oz-eq	5 oz-eq	5 oz-eq	6 oz-eq	6 oz-eq	7 oz-eq	8 oz-eq	9 oz-eq	10 oz-eq	10 oz-eq	10 oz-eq
Whole grains	1½ oz-eq	2 oz-eq	2½ oz-eq	3 oz-eq	3 oz-eq	3 oz-eq	3½ oz-eq	4 oz-eq	4½ oz-eq	5 oz-eq	5 oz-eq	5 oz-eq
Enriched grains	1½ oz-eq	2 oz-eq	2½ oz-eq	2 oz-eq	3 oz-eq	3 oz-eq	3½ oz-eq	4 oz-eq	4½ oz-eq	5 oz-eq	5 oz-eq	5 oz-eq
Vegetables^d	1 c	1½ c	1½ c	2 c	2½ c	2½ c	3 c	3 c	3½ c	3½ c	4 c	4 c
Dark-green vegetables	½ c/wk	1 c/wk	1 c/wk	1½ c/wk	1½ c/wk	1½ c/wk	2 c/wk	2 c/wk	2½ c/wk	2½ c/wk	2½ c/wk	2½ c/wk
Red and orange vegetables	2½ c/wk	3 c/wk	3 c/wk	4 c/wk	5½ c/wk	5½ c/wk	6 c/wk	6 c/wk	7 c/wk	7 c/wk	7½ c/wk	7½ c/wk
Beans and peas (legumes)	½ c/wk	½ c/wk	½ c/wk	1 c/wk	1½ c/wk	1½ c/wk	2 c/wk	2 c/wk	2½ c/wk	2½ c/wk	3 c/wk	3 c/wk
Starchy vegetables	2 c/wk	3½ c/wk	3½ c/wk	4 c/wk	5 c/wk	5 c/wk	6 c/wk	6 c/wk	7 c/wk	7 c/wk	8 c/wk	8 c/wk
Other vegetables	1½ c/wk	2½ c/wk	2½ c/wk	3½ c/wk	4 c/wk	4 c/wk	5 c/wk	5 c/wk	5½ c/wk	5½ c/wk	7 c/wk	7 c/wk
Fruit^d	1 c	1 c	1½ c	1½ c	1½ c	2 c	2 c	2 c	2 c	2½ c	2½ c	2½ c
Protein foods^d	2 oz-eq	3 oz-eq	4 oz-eq	5 oz-eq	5 oz-eq	5½ oz-eq	6 oz-eq	6½ oz-eq	6½ oz-eq	7 oz-eq	7 oz-eq	7 oz-eq
Dairy^f	2 c	2½ c	2½ c	3 c	3 c	3 c	3 c	3 c	3 c	3 c	3 c	3 c
Meat, poultry, eggs	10 oz/wk	14 oz/wk	19 oz/wk	24 oz/wk	24 oz/wk	26 oz/wk	29 oz/wk	31 oz/wk	31 oz/wk	34 oz/wk	34 oz/wk	34 oz/wk
Seafood	3 oz/wk	5 oz/wk	6 oz/wk	8 oz/wk	8 oz/wk	8 oz/wk	9 oz/wk	10 oz/wk	10 oz/wk	11 oz/wk	11 oz/wk	11 oz/wk
Nuts, seeds, soya products	1 oz/wk	2 oz/wk	3 oz/wk	4 oz/wk	4 oz/wk	4 oz/wk	4 oz/wk	5 oz/wk	5 oz/wk	5 oz/wk	5 oz/wk	5 oz/wk
Oils^g	15 g	17 g	17 g	22 g	24 g	27 g	29 g	31 g	34 g	36 g	44 g	51 g
Maximum SoFAS^h limit, calories (% of calories)	137 (14%)	121 (10%)	121 (9%)	121 (8%)	161 (9%)	258 (13%)	266 (12%)	330 (14%)	362 (14%)	395 (14%)	459 (15%)	596 (19%)

See next page for foot notes

- b. Food group amounts are shown in cup (c) or ounce-equivalents (oz-eq). Oils are shown in grams (g). Quantity equivalents for each food group are:
Grains, 1 ounce-equivalent is: 1 one-ounce slice bread; 1 ounce uncooked pasta or rice; ½ cup cooked rice, pasta, or cereal; 1 tortilla (6" diameter); 1 pancake (5" diameter); 1 ounce ready-to-eat cereal (about 1 cup cereal flakes).
Vegetables and fruit, 1 cup equivalent is: 1 cup raw or cooked vegetable or fruit; ½ cup dried vegetable or fruit; 1 cup vegetable or fruit juice; 2 cups leafy salad greens. Protein foods, 1 ounce-equivalent is: 1 ounce lean meat, poultry, seafood; 1 egg; 1 Tbsp peanut butter; ½ ounce nuts or seeds. Also, ¼ cup cooked beans or peas may also be counted as 1 ounce-equivalent. Dairy, 1 cup equivalent is: 1 cup milk, fortified soya beverage, or yogurt; 1½ ounces natural cheese (e.g., cheddar); 2 ounces of processed cheese (e.g., American).
- c. See Appendix 6 for estimated calorie needs per day by age, sex, and physical activity level. Food intake patterns at 1,000, 1,200, and 1,400 calories meet the nutritional needs of children aged 2 to 8 years. Patterns from 1,600 to 3,200 calories meet the nutritional needs of children aged 9 years and older and adults. If a child aged 4 to 8 years needs more calories and, therefore, is following a pattern at 1,600 calories or more, the recommended amount from the dairy group can be 2½ cups per day. Children aged 9 years and older and adults should not use the 1,000, 1,200, or 1,400 calorie patterns.
- d. Vegetable and protein foods subgroup amounts are shown in this table as weekly amounts, because it would be difficult for consumers to select foods from all subgroups daily.
- e. Wholegrain subgroup amounts shown in this table are minimums. More whole grains up to all of the grains recommended may be selected, with offsetting decreases in the amounts of enriched refined grains.
- f. The amount of dairy foods in the 1,200 and 1,400 calorie patterns have increased to reflect new RDAs for calcium that are higher than previous recommendations for children ages 4 to 8 years.
- g. Oils and soft margarines include vegetable, nut, and fish oils and soft vegetable oil table spreads that have no trans fats.
- h. SoFAS are calories from solid fats and added sugars. The limit for SoFAS is the remaining amount of calories in each food pattern after selecting the specified amounts in each food group in nutrient-dense forms (forms that are fat-free or low-fat and with no added sugars). The number of SoFAS is lower in the 1,200, 1,400, and 1,600 calorie patterns than in the 1,000 calorie pattern. The nutrient goals for the 1,200 to 1,600 calorie patterns are higher and require that more calories be used for nutrient-dense foods from the food groups

Appendix E

Table 63 Some expert or relevant groups in Ireland

Irish Universities Nutrition Alliance	IUNA comprises four academic nutrition units from University College Cork, University of Ulster, Trinity College Dublin and University College Dublin.	http://www.iuna.net/
FSAI Food Safety Authority of Ireland	Food Safety Authority of Ireland Abbey Court, Lower Abbey Street, Dublin 1	http://www.fsai.ie/
INDI Irish Nutrition & Dietetic Institute	Ashgrove House, Kill Avenue, Dun Laoghaire, Co. Dublin	https://www.indi.ie/
Health Service Executive Healthy Eating and Nutrition	Healthy Eating and Nutrition Oak House, Health Office Millennium Park, Naas, Co. Kildare	http://www.hse.ie/eng/services/list/4/olderpeople/tipsforhealthyliving/healthy_eating.html
Crème Global	Commercial company whose servings include statistical modelling	http://www.cremeglobal.com/

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Note to readers on Website links

Report links in this review are included to assist the reader to access the relevant sites and are valid at the time of writing (September 2014). However, nation and international bodies may over time change the location of their publication. Where this occurs it is usually possible to access the publication of interest by entering the relevant publication name into the organisation's website or directly into your engine search box.

In a small number of cases – links for the food images – lead to Wikipedia sites, as English translations were not available for these images in the national website.