Chapter 12

Nutrition Labelling: Educational Tool for Reducing Risks of Obesity-Related Non-communicable Diseases

Visith Chavasit, Wantanee Kriengsinyos,

Mayuree Ditmetharoj, Manasuwee Phaichamanan,

Kangsadan Singsoong, Prapaisri Sirichakwal and

Araya Rojjanawanicharkorn

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/65728

Abstract

Food and nutrition education is globally recognized as the most efficient tool for reducing the risks of non-communicable diseases (NCDs). For decades, different nutrition labelling formats found on the back of food packages have been used as educational tools to provide information on amounts of nutrients for preventing both under- and over-nutrition. However, these traditional panels have proven to be ineffective for consumer education due to their complexity. Other systems, so-called 'Simplified Nutrition Labelling', which are normally shown on the front of a food package, were then introduced as 'Front-of-Pack, FOP' labelling. These labelling panels normally contain only the nutrients that relate to NCDs and that should be limited for consumption. At least four types of FOP nutrition labelling panels exist, namely, nutrient specific, summary indicator, food group information and hybrids. These panels using different patterns provide consumers with three types of information: non-evaluative, evaluative or interpretative and conclusive. In this chapter, the advantages and disadvantages of different types of nutrition labelling are discussed, especially their roles in reducing the risk of obesity-related NCDs in a population.

Keywords: nutrition labelling, front-of-pack, non-communicable diseases, nutrition education, nutrition in transition

1. Introduction

Currently, nutrition in transition can be found globally even in most developing countries. Declining under-nutrition is occurring in parallel with increases in over-nutrition, obesity and non-communicable diseases (NCDs). A double burden of malnutrition is now affecting the world population's quality of life.

For decades, nutrition education has been recognized as a preventive strategy for the sustainable reduction of both under- and over-nutrition. International organizations have developed guidelines for healthy eating that countries have adopted for preparing more practical food-based dietary guidelines (FBDGs). More simplified FBDGs were later developed in different graphical designs according to national cultures and eating contexts. These FBDGs have been modified periodically by including additional factors other than foods that affect the nutrition and health statuses of population.

Industrially-produced foods are the other important sources of nutrients for people especially in more developed countries. An attempt in using industrial food products as an education tool for populations exists in terms of nutrition labelling, which indicates the amounts of certain selected nutrients on food package.

The traditional nutrition labelling panel, which contains amounts of nutrients that reduce risks of under- and over-nutrition, has been mandated in many countries. Data on these traditional nutrition labelling panels are normally tabulated and located on the back of food package or so called 'Back of Pack, BOP' nutrition labelling panel. After several years of implementation, the traditional BOP nutrition labelling panels were found to be inefficient tools for educating consumers, due to such causes as their hidden location on shelves, complicated information and unattractive design. Consumers generally did not use the panel, and it did not attract industries to reformulate their recipes towards healthier nutrient profiles. A more effective nutrition educational tool is now needed as the problems of overweight, obesity and non-communicable diseases have become serious nutrition issues worldwide, especially among the people of low socio-economic classes and with less education.

A simplified nutrition label in graphic format was introduced in the 1960s intentionally to conquer over-nutrition, and later more designs and types were widely developed. Among these differences, the common agreement was on the nutrients used for criteria development, which were basically related to non-communicable diseases, for example fat, sodium and sugar. In addition, this simplified nutrition labelling panel was located on the front of food package or so called 'Front-of-Pack, FOP' nutrition labelling panel. These panels of different types and different degrees of informativeness have been recognized differently by different groups of stakeholders within the food system. Most FOP nutrition labelling panels are still implemented on a voluntary basis. In this chapter, the logic behind the development of traditional and simplified nutrition labelling panels are discussed as well as their uses in many countries.

http://dx.doi.org/10.5772/65728

2. Global nutrition in transition

For decades in many parts of the world, protein energy malnutrition (PEM) and micro-nutrient deficiencies have been significant health burdens. Consequently, tremendous investments have been made in programs to alleviate these under-nutrition issues. However, most malnutrition scenarios arise not just from a lack of sufficient, adequately nutritious and safe food. A host of other interacting processes also play a role, for example healthcare, education, sanitation and hygiene, agriculture, trade, access to resources, women empowerment and more [1]. Consequently, a multidisciplinary approach involving different stakeholders, such as public health, agriculture, education and local authorities, must be implemented with the involvement of communities. The applied knowledge of these stakeholders as well as strong contributions and the cooperation of communities are important requirements for the production and consumption of nutritious and safe foods. For example, improvements in human quality of life, via efficient sanitation and nutrition programs, can successfully reduce morbidity and mortality due to nutrient deficiencies and communicable diseases. Over the past four decades, this multidisciplinary approach has been tested and implemented on a large scale in several developing countries. Thailand is one such success story where PEM among under-5 year old children was drastically reduced after 20 years of implementing this approach (**Figure 1**).

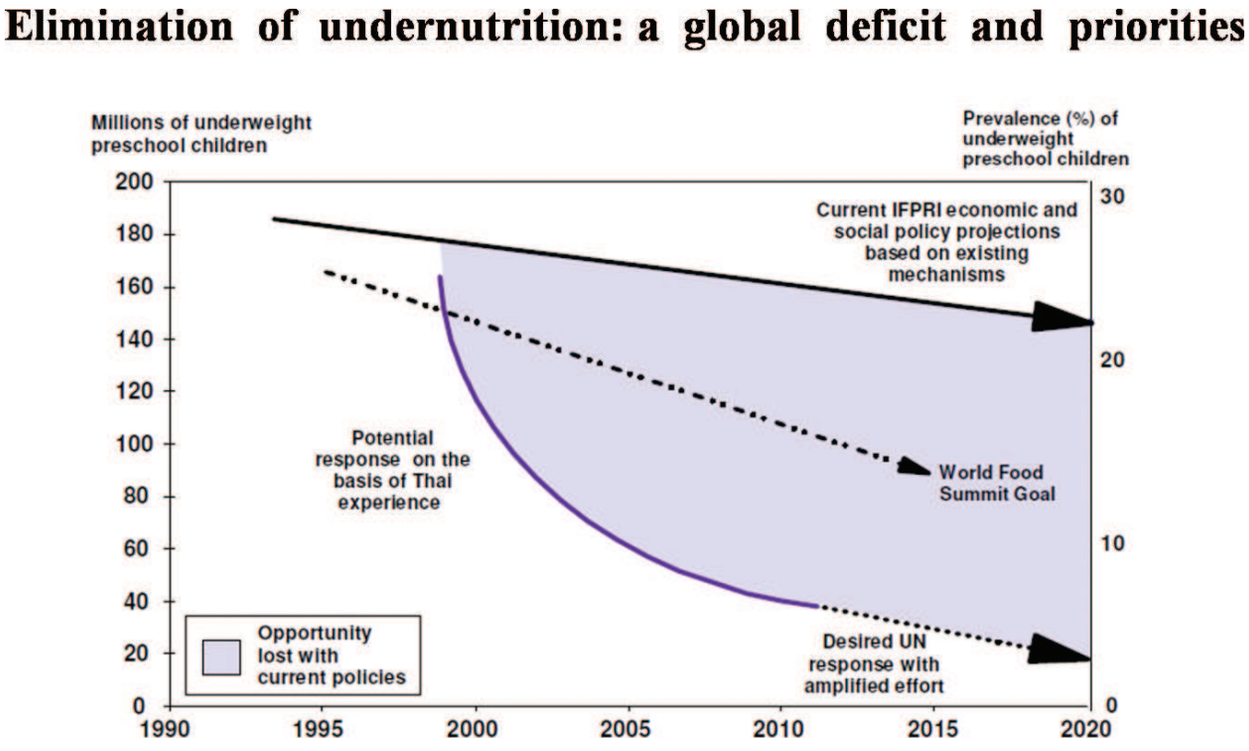


Figure 1. The World Food Summit Goal in reducing underweight problem in school children, the current situation of most countries and the Thailand's experience. *Source*: Ending malnutrition by 2020: an agenda for change in the millennium. Final Report to the ACC/SCN by the Commission on the nutrition challenges of the twenty-first century.

Among many supporting factors, food and nutrition education is one of the keys to success. As information is modified and simplified to fit community contexts, understandable messages and practical guidance can be passed to consumers. In the case of Thailand, the messengers were village health volunteers—at a ratio of 1 volunteer per 10 households—who distributed important nutrition information all over the country. Effective communication proved to be a powerful tool for altering consumer behaviours in the food system.

It must be recognized, however, that economic development is also a significant factor for success in solving a country's under-nutrition challenges. It can allow a country to invest more in nutrition and increase people's access to nutritious and safe foods. Under-nutrition problems in many countries have shown improvement as national economies have grown in strength (**Figure 2**). As a consequence of economic development, potentially more nutritious, safe and energy-rich foods can be available, affordable and accessible by people of varying socio-economic statuses. Economic development and industrialization provide more food choices in marketplaces, which have changed food environments in many countries.

The roles of food industries nowadays have also become more significant in the daily diets of the world's populations, and not always for the better. Globalization and modernization have drastically changed people's lifestyles in developing countries that formerly had a more balanced way of living. Traditional and imported energy-rich foods can be easily accessed in fresh markets, convenience stores, supermarkets, food vendors, local restaurants and multinational franchise restaurants due to better logistics, more modern and economical agricultural and

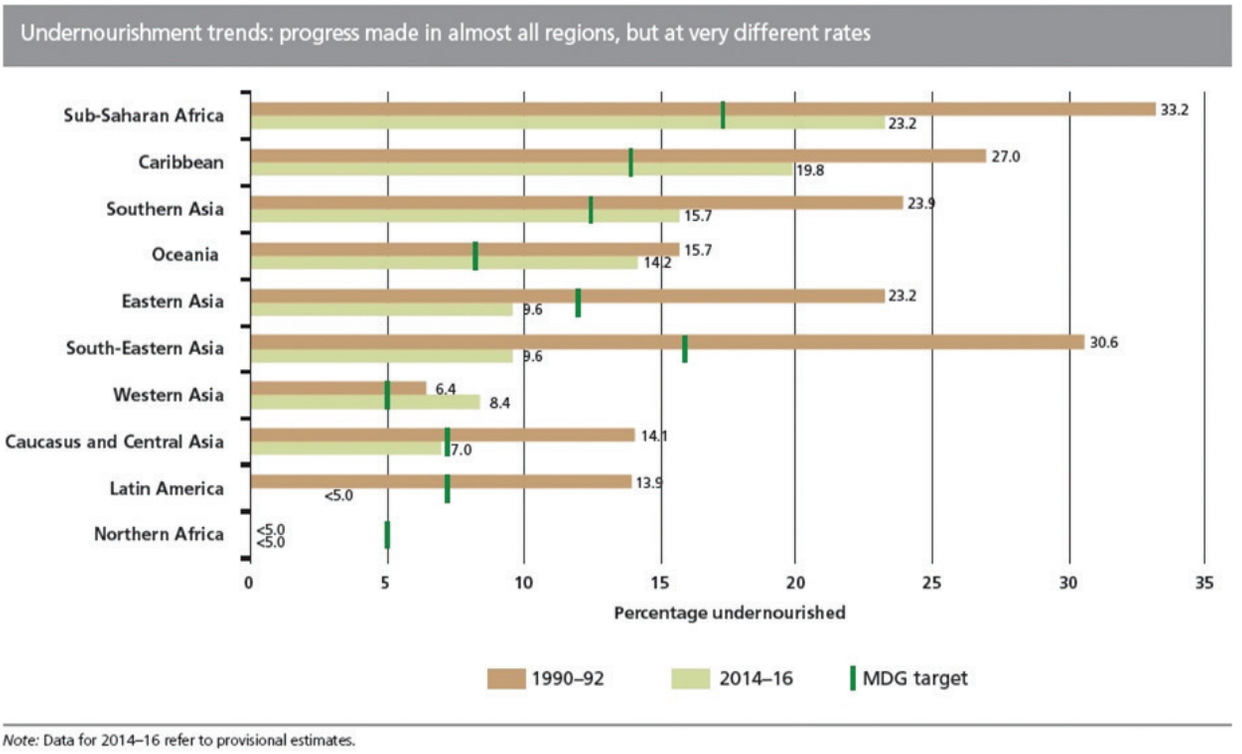


Figure 2. World situation on protein energy malnutrition (PEM) problem. *Source*: http://www.fao.org/hunger/key-messages/en/.

http://dx.doi.org/10.5772/65728

industrial production technologies and free trade agreements. Unfortunately, though, messages from food businesses can, in part, be based on fact, but they can also contain misleading information. Deceptive food advertisements and sales promotions can create an unhealthy food environment for consumers by promoting the excessive consumption of energy-, sugar-, saturated fat- and sodium-rich foods. In such an environment, physically easy or sedentary lifestyles, which result in low physical activity and less energy expenditure in everyday life, promote unbalanced nutrition. A mentally stressful lifestyle, furthermore, can cause a negative impact on non-communicable diseases.

Allied, often well-meaning, government health programs can also affect a population's nutritional status. For example, successful family planning programs have led to very low population fertility rates in many countries (lower than 2.1). Due to lower birth rates as well as better public health care, these countries have steadily seen a decline in working age people and a growing elderly population (**Figure 3**). As the ratio of elderly people increases, these countries are faced with an ageing society with the expectation that a longer life will also be a healthy life. However, non-communicable diseases often come to the forefront, since they are found more often in older age population groups who are physiologically prone to the diseases, especially among overweight and obese individuals. Changes in food availability, lifestyle and population profiles, therefore, can exacerbate expanding problems of NCDs. The increase in NCDs in developing countries—where under-nutrition used to be the main nutrition problem but has improved—can partly be explained by using Barker's theory, as well. Some persons found within a population affected by NCDs were born malnourished and were low-birth-weight newborns. Their bodies adapted to an environment that was chronically short of food. In adulthood and living in a more affluent environment, they become more prone to metabolic disorders, such as obesity and type II diabetes [2].

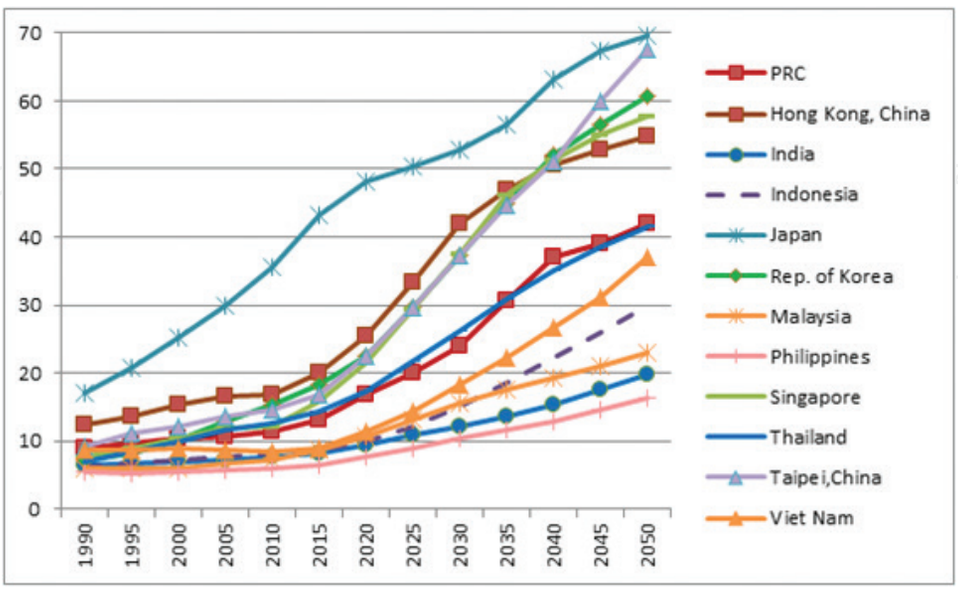


Figure 3. The trend of the ratio (%) of the population aged 65 and over to the working-age population (aged 15–64) through the year 2050. *Source*: http://www.asiapathways-adbi.org/2015/02/why-do-we-need-financial-education-in-asia/.

While under-nutrition in the form of PEM and micro-nutrient deficiencies remains unsolved in many developing countries, unfortunately the challenge of over-nutrition has also rapidly emerged, thus presenting the world with a double-burden in terms of malnutrition. Incidences of overweight, obesity and diet-related NCDs, which were mainly found in more affluent developed countries, are now growing in many developing countries at an alarming rate. The worldwide prevalence of obesity more than doubled between 1980 and 2014. Globally, NCDs are now the leading causes of death. Cardiovascular diseases, diabetes, cancer and chronic respiratory diseases caused up to 68% of deaths in 2012 [3]. Almost three-quarters of all NCD deaths occur in low- and middle-income countries [4]. Four major risk factors have been primarily responsible for the rise in NCDs are tobacco use, physical inactivity, alcohol use and unhealthy diets [5]. The rapid rise in NCDs is predicted to impede poverty reduction in low-income countries, particularly by increasing household costs associated with health care. Vulnerable and socially disadvantaged people become ill and die sooner than people of higher socio-economic status, since they are at higher risk of being exposed to harmful products, such as tobacco or unhealthy food, and have limited access to health services. To lessen the impact of NCDs on individuals and society, a comprehensive approach is needed that requires all sectors, including health, finance, foreign affairs, education, agriculture, planning and others, to work together to reduce the risks associated with NCDs, as well as promote interventions to prevent and control them. A global action plan for the prevention and control of NCDs 2013–2020 was initiated by WHO and member states. This plan aims to reduce the number of premature deaths from NCDs by 25% by 2025 [6].

Malnutrition, in every form, presents significant threats to human health. Today the world faces a double burden of malnutrition that includes both under-nutrition and over-nutrition, especially in developing countries (**Table 1**). Hunger and inadequate nutrition contribute to early deaths among mothers, infants and young children, and impaired physical and brain development in young children. Meanwhile, growing rates of overweight and obesity are linked to a rise in life-threatening chronic diseases (e.g. hypertension, stroke, cardiovascular disease, diabetes, cancer) that are difficult to treat in places with limited resources and already overburdened health systems. Nutrition problems that emerge in either direction impair individual productivity, which slow down national growth. The cost of malnutrition is approximately 3.5 trillion USD per year [7].

3. Guideline for healthy eating

3.1. Balanced diet

Consuming a healthy diet throughout life is one key for maintaining strength and good health. Eating a wide variety of foods in the right proportions can achieve and maintain healthy body weight and prevent malnutrition of all forms as well as a range of NCDs. Foods from nature provide both nutrients and non-nutrients that benefit human health. The basic elements, or nutritional requirements, for a healthy diet must include the right amounts of energy, protein, fat, carbohydrates, vitamins, minerals and water for the body. These requirements, in fact, differ for different individuals and at different life stages. However, sets of

http://dx.doi.org/10.5772/65728

Under-nutrition	Over-nutrition
- About 104 million children under age 5 worldwide (2010) are underweight and 171 million stunting - More than one-third of preschool-age children globally are Vitamin A deficient	- About 1.5 billion people are overweight worldwide, of whom 500 million are obese (2008) - About 43 million children under age 5 were overweight in 2010
- Maternal under-nutrition, leads to poor foetal development and higher risk of pregnancy complications - 13 million children are born with low birth weight or prematurely due to maternal under-nutrition and other factors	- Growing rates of maternal overweight are leading to higher risks of pregnancy complications and heavier birth weight and obesity in children
- Maternal and child under-nutrition account for more than 10% of the global burden of disease - Under-nutrition contributes to about one-third of all child deaths	- At least 2.6 million people die each year as a result of being overweight or obese

Source: WHO Nutrition Challenges 2014, http://www.who.int/nutrition/challenges/en/August 12, 2016.

Table 1. Impacts from double burden malnutrition in the world as quoted by World Health Organization in 2010.

nutrient requirements have been established for general populations living in many countries. These sets go by different names, such as Dietary Reference Intake (DRI) in the United States and Canada, Dietary Reference Values (DRV) in the United Kingdom, etc. The human body needs different nutrients for different functions in differing amounts. Carbohydrate, fat and protein—known as 'macronutrients'—are required in much larger amounts than minerals and vitamins that are called 'micro-nutrients'. In addition, the human body's physiological function is also regulated by non-nutrient substances that are found naturally in food. Consequently, the term 'balanced diet' must contain the right amounts of the right kinds of nutrients and non-nutrients. Nutrient and non-nutrient requirements for a healthy diet are, in fact, quite individualized, since they relate to genetics, age, gender, physical activity and health status of an individual.

3.2. Food-based dietary guidelines

Information contained in the FAO/WHO recommendations on energy, protein and nutrient requirements is quite abstract and difficult for consumers to understand. Consequently, a simplified message was developed in terms of Food-Based Dietary Guidelines (FBDG) by transforming nutrients into food groups for better understanding. In the Cyprus meeting in 1995, FAO and WHO in collaboration with experts developed eating guidelines for healthy lifestyles for preventing under-nutrition, over-nutrition and unsafe food consumption [8]. These guidelines serve as principles for countries to adopt and adapt as their own guidelines. Upon implementation, a guideline can be periodically revised in line with current scientific evidence. Over 100 countries worldwide have developed their own FBDGs that are suitable for their own nutrition situations, food availability, culinary cultures and eating habits. From the simplified message, FBDGs have been developed into more consumer-friendly formats, especially in terms of graphic design. Examples of graphical FBDGs from different countries are shown in **Figure 4**. Many of the designs are specific to the cultures of implementing countries. In addition, a design can also be modified if it proves to be an ineffective tool for consumer education, especially for preventing NCDs. For example, the USA's graphical

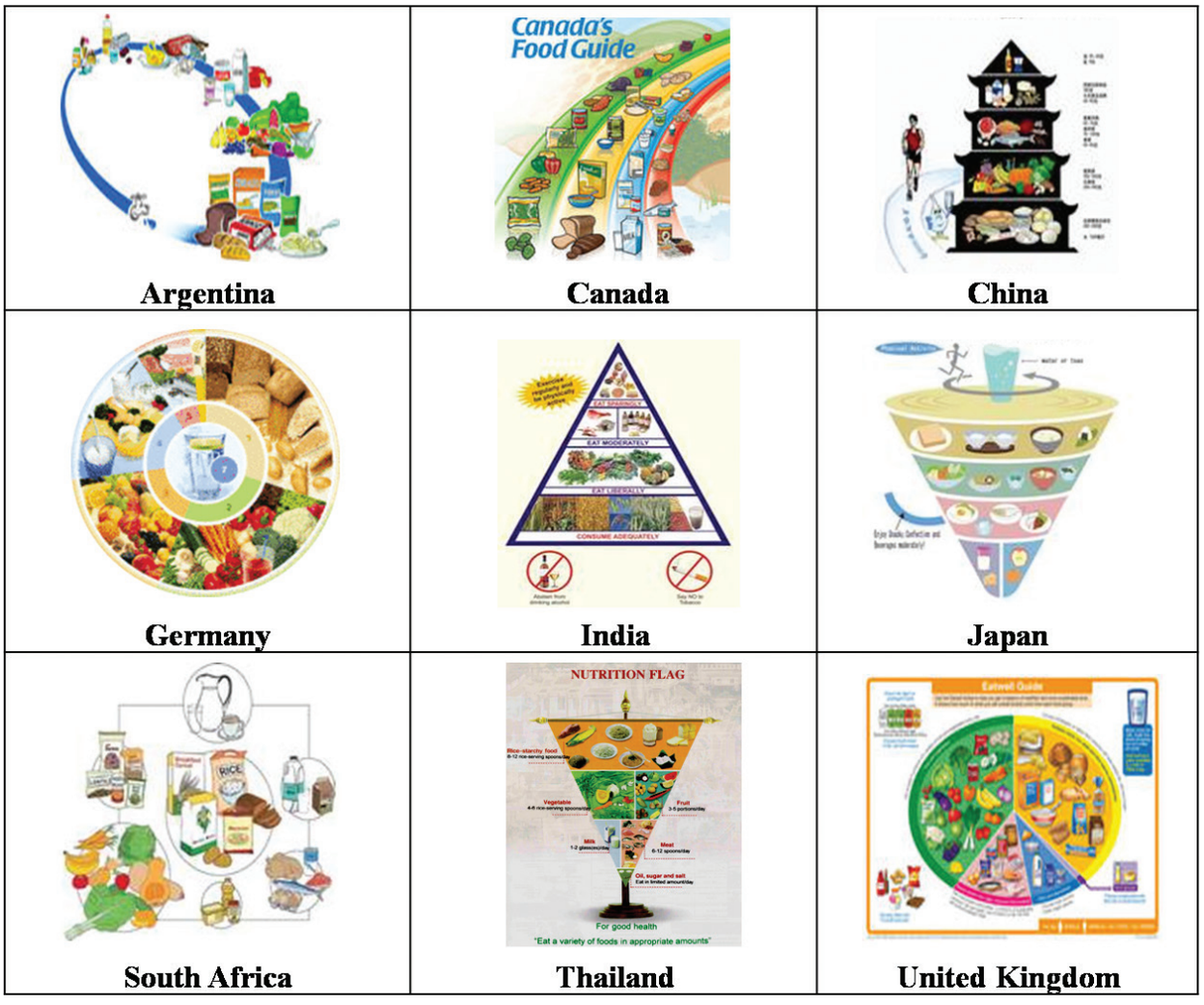


Figure 4. Examples of graphical FBDGs implemented in different countries. *Source*: http://www.fao.org/nutrition/nutrition-education/food-dietary-guidelines/en/.

FBDG was changed from a pyramid pattern into a plate pattern (**Figure 5**). In addition, many countries later included exercise in their graphical FBDGs, since food alone cannot lead to a healthy life. Messages on the graphical FBDGs of every country are similarly shown as food groups, not nutrients, which general consumers can more easily understand.

3.3. Nutrient reference values for nutrition labelling

In 1941, the Food and Nutrition Board first developed a set of recommended nutrient requirements known as recommended dietary allowances or RDAs. These allowances were meant to provide 'nutrients beyond enough' for civilians and military personnel, since the values included a 'margin of safety' [9]. The established values for a nutrient can be different for different requirements due to age and gender. These RDAs were subsequently revised every 5–10 years until 1997 when dietary reference intake (DRI) was introduced in order to broaden the existing RDA system. The DRI consisted of a set of four reference values: (i) estimated average requirements (EARs) wherein the average nutrient intake satisfies the needs of 50%

http://dx.doi.org/10.5772/65728

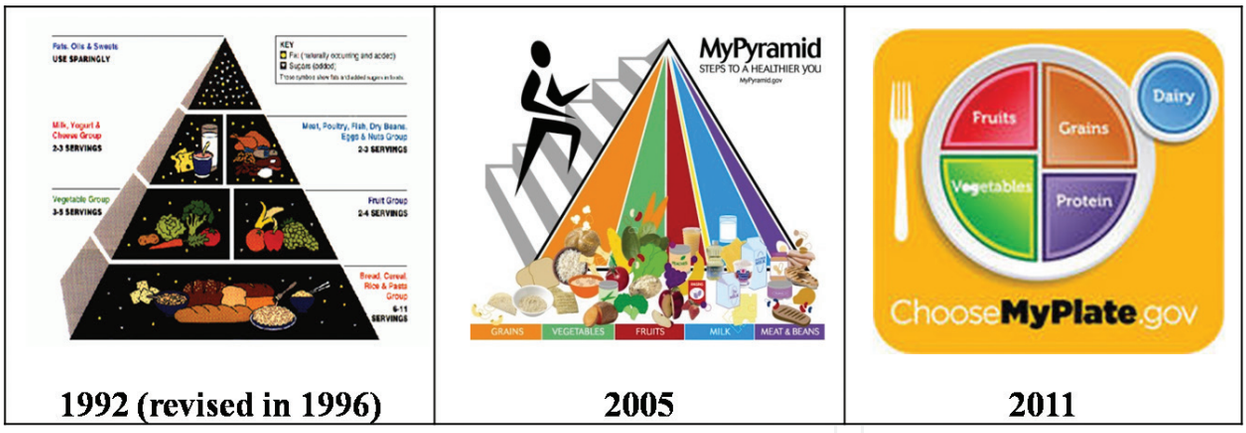


Figure 5. Series of changes in USA's graphical FBDGs. *Source*: http://www.cnpp.usda.gov.

of healthy individuals, (ii) recommended dietary requirements (RDA) or nutrient amounts sufficient to meet the requirements of 97.5% of a population, (iii) adequate intake (AI) or the approximate value determined from observations or experiments on nutrient intake from a group or groups of healthy people (where there was no established RDA) and (iv) tolerable upper intake (UL) or the highest level of nutrient intake that is considered to be safe and causes no side effects in most people [10]. Since these sets of values were developed for specific purposes, they could be adopted directly for use as references among general consumers.

In 1985, CODEX grouped nutrients into a single set and established their reference values known as 'nutrient reference values-requirements (NRVs-R)' to be used for individuals aged older than 36 months as shown in **Table 2** [11]. Most of the NRVs-R values are similar to those listed in the RDA. The CODEX values are meant to be used as references in preparing nutrition labels for consumer education. It is expected that a consumer can decide the appropriateness of a food for his/her health by considering what percentage of a nutrient's daily requirement (%NRVs) can he/she obtain from eating a portion of a food. Percentage NRVs is meant to help consumers in making correct food choices for their health. Other than the term NRVs-R as defined by CODEX, other terminologies have been developed, such as daily value (DV) used by the U.S. Food and Drug Administration (USFDA) for their Nutrition Fact Panel (NFP). Moreover, nutrient reference values–non-communicable disease (NRVs-NCD) has also been specifically established by CODEX for consumer education in order to educate the risks of NCDs.

3.4. Nutrients related to the risks of NCDs

To prevent diet-related NCDs, WHO recommended healthy populations to limit their intake of saturated fat, *trans* fat, cholesterol, sugar, sodium and total energy, while ensuring adequate intakes of carbohydrate, protein and dietary fibre [12, 13]. Nutrient intake goals for preventing NCDS are shown in **Table 3**. Similarly, the FBDGs of most countries recommend limiting the consumption of fat, sugar or salt, as well as foods and beverages high in energy. For fat, concern is placed on not only the quantity but also the quality of fat consumed, especially saturated fats and *trans* fat. In addition, and based on convincing evidence, CODEX

Nutrients	Values of NRV-R
Vitamins	
Vitamin A (μg)	800*
Vitamin D (μg)	5**
Vitamin C (μg)	60
Vitamin K (μg)	60
Thiamin (mg)	1.2
Riboflavin (mg)	1.2
Niacin (mg NE)	15**
Vitamin B6 (mg)	1.3
Folate (μ DFE)	400
Folic acid (μg)	200
Vitamin B12 ((μg)	2.4
Pantothenate (mg)	5
Biotin (μg)	30
Minerals	
Calcium (mg)	1000
Magnesium (mg)	300
Iron (mg)	14
Zinc (mg)	15
Iodine (μg)	150**
Copper	Value to be established
Selenium	Value to be established
Protein	50

* For the declaration of β-carotene (provitamin A) the following conversion factor should be used: 1 μg retinol = 6 μg β-carotene.

**Nutrient reference values for vitamin D, niacin and iodine may not be applicable for countries where national nutrition policies or local conditions provide sufficient allowance to ensure that individual requirements are satisfied.

Table 2. A set of numerical values of nutrient requirements (NRV-R) that are based on scientific data for purposes of nutrition labelling and relevant claims.

established NRVs-NCD that recommended limiting saturated fat and sodium—two main nutrients for lowering risks of NCDs—to not higher than 20 g and 2000 mg/day, respectively [11]. *Trans* fat is classified as the worst quality fat with recommended consumption at less than 1% of total energy. *Trans* fat increases blood low-density lipoprotein (bad) cholesterol as well as decreases high-density lipoprotein (good) cholesterol. The USFDA stated that partially hydrogenated oils (PHOs) are the primary dietary source of artificial *trans* fat in processed foods and must not be classified as 'generally recognized as safe' or GRAS for use in human food [14]. In contrast, increased intake of fruits, vegetables, whole grains and nuts is

http://dx.doi.org/10.5772/65728

Dietary factor	1989 WHO study group recommendations	2002 Joint WHO/FAO expert consultation recommendations (CODEX)	Rationale for Joint WHO/FAO expert consultation recommendations
Total fat	15–30%	15–30%	Obesity/CVD/diabetes
Saturated fatty acids (SFAs)	0–10%	<10%	Diabetes/CVD
Polyunsaturated fatty acids (PUFAs)	3–7%	6–10%	CVD
n-6 PUFAs	55–75%	5–8%	CVD
n-3 PUFAs	0–10%	1–2%	CVD
Trans fatty acids		<1%	CVD
Monounsaturated fatty acids (MUFAs)		By difference[a]	
Total carbohydrate	55–75%	55–75%[b]	
Free sugars[c]	0–10%	<10%	Obesity/dental diseases
Complex carbohydrate	50–70%	No recommendation	
Protein	10–15%	10–15%[d]	
Cholesterol	0–300 mg	<300 mg/d	CVD
Sodium chloride (sodium)[e]	<6 g/d	<5 g/d (<2 g/d)	
Fruits and vegetables	≥ 400 g/d	≥400 g/d	CVD/cancer
Pulses, nuts and seeds	≥ 30g/d (as part of the 400 g of fruit and vegetables)		
Total dietary fibre	27–40 g/d	From food[f]	Obesity/diabetes/
Non-starch polysaccharides (NSP)	16–24 g/d	From food[f]	CVD/cancer

Notes: [a]This is calculated as total fat – (SFAs + PUFAs + *trans* fatty acids).
[b]The percentage of total energy available after taking into account that consumed as protein and fat, hence the wide range.
[c]The term 'free sugars' refers to all monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, plus sugar naturally present in honey, syrups and fruit juices.
[d]The suggested range should be seen in the light of the Joint WHO/FAO/Consultation on Protein and Amino Acid Requirements in Human Nutrition, held in Geneva from 9 to 16 April 2002.
[e]Salt should be iodized appropriately. The need to adjust salt iodization, depending on observed sodium intake and surveillance of iodine status of the population, should be recognized.
[f]Wholegrain cereals, fruits and vegetables are the preferred sources of NSP. The recommended intake of fruits and vegetables and consumption of wholegrain foods is likely to provide >20 g per day of NSP (>25 g per day of total dietary fibre).
[*]Adapted from Diet, nutrition and the prevention of chronic diseases. Report of a joint WHO/FAO expert consultation (WHO Technical Report Series 916) [13].

Table 3. Recommendations for nutrient intakes in population by WHO and CODEX* (% of total energy, unless otherwise stated).

recommended by all organizations for preventing NCDs. An average intake of a minimum of 400 g of fruits and vegetables per day, or five servings, is recommended for preventing the risks of NCDs, such as heart disease, cancer, diabetes and obesity [13]. Eating a variety of vegetables and fruits clearly ensures an adequate intake of potassium and most micro-nutrients,

dietary fibre and a host of essential non-nutrient substances. The consumption of fruits and vegetables can replace foods high in saturated fats, sugar or salt.

Balanced eating at all life stage, beginning with conception, is crucial for preventing chronic diseases. Over the last two decades, growing evidence has shown that *in utero*, infant and young child under-nutrition are directly linked to vulnerability to adult NCDs [2, 15]. Consequently, public health and nutrition interventions during the first 1000 days of life, or from conception to 2 years of age, are encouraged.

It is globally accepted that deaths related to NCDs can be partly reduced by investments to promote healthy diets following WHO's recommended eating pattern among populations. Appropriate information via food and nutrition labelling, as well as restrictions on the marketing of unhealthy foods, are major interventions to promote healthy diets [16] (**Figure 6**).

4. Nutrition labelling

Consumer education is an efficient tool for addressing malnutrition challenges. However, it must use effective messages, delivered by effective media and under the right environment. Nutrition labelling on packaged foods is widely used as an educational tool to provide consumers with nutrition information about specific food products. It is intentionally used as

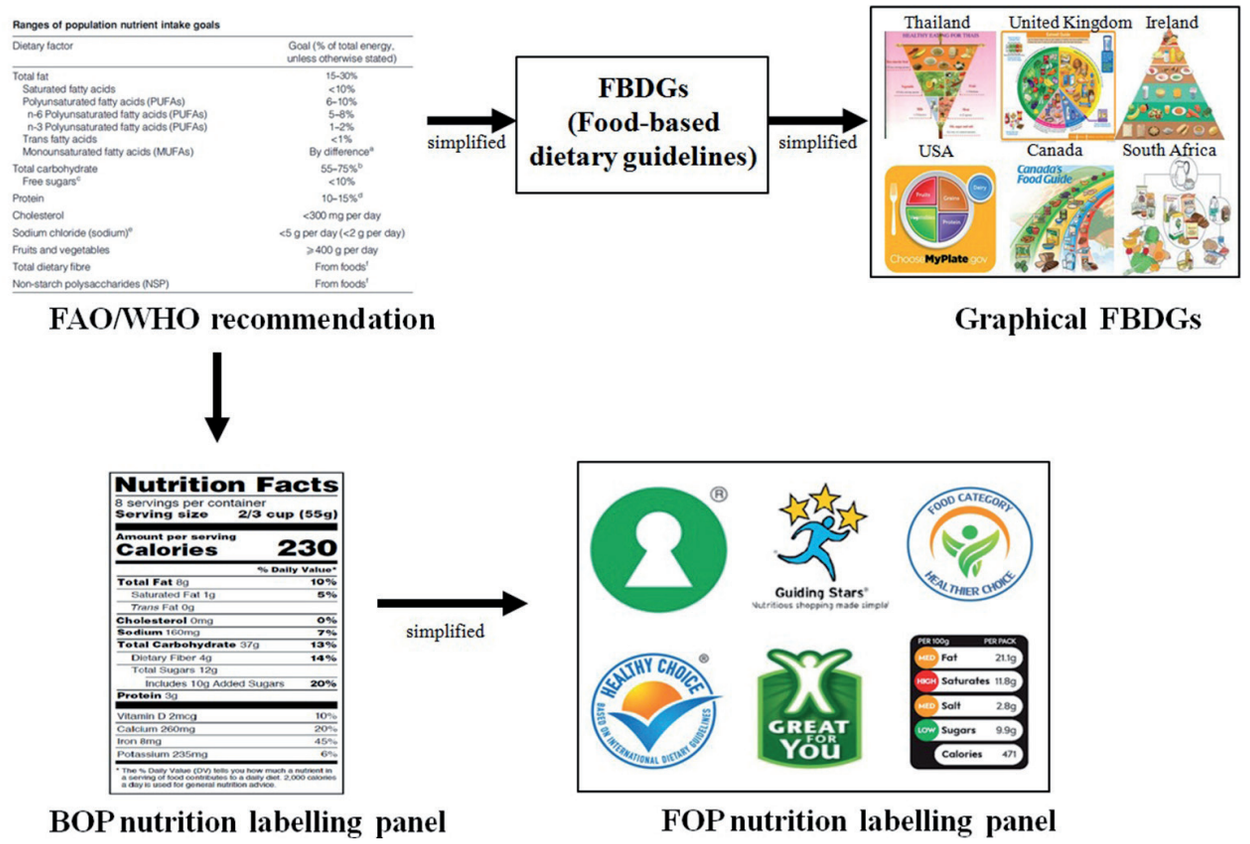


Figure 6. From healthy eating recommendations to different interventions for consumer education.

http://dx.doi.org/10.5772/65728

a tool for enabling general consumers to select foods that are appropriate for their health. Ideally, nutritionally educated consumers should be the demand for creating a healthy-food environment. Moreover, nutrition labelling is also used as a marketing tool for the food industry in terms of product reformulation and market expansion of packaged food products around the world [11, 17].

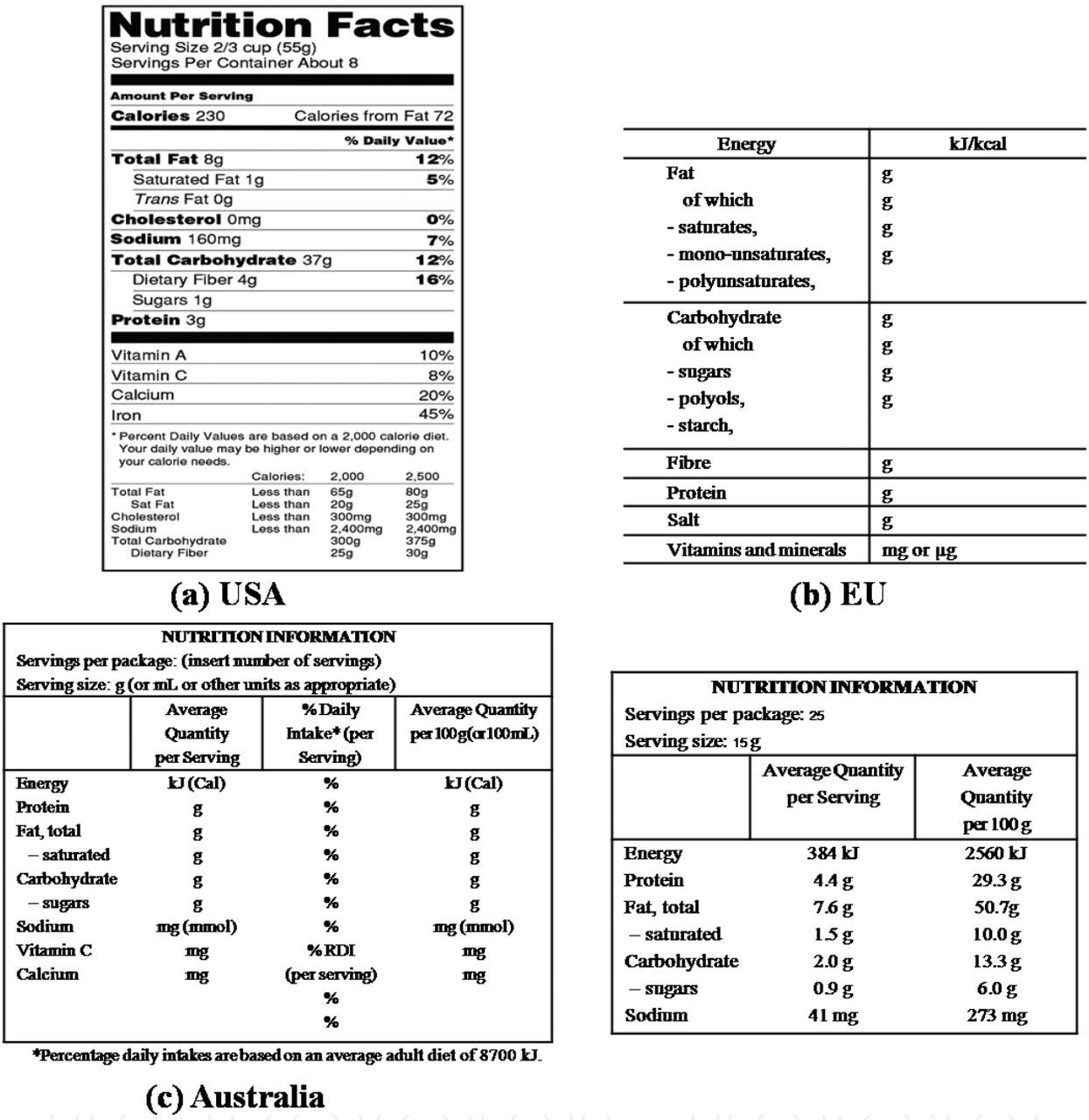
According to the CODEX Guidelines on Nutrition Labelling (CAC/GL 2-1985), the nutrient declaration should be mandated for all pre-packaged foods if nutrition or health claims are made. Two formats exist for the nutrition labelling panel, namely, a traditional format and a graphical format [17]. Nutrition labels using the traditional format are normally located on the back side of food packages, while graphical format panels use a simplified format and are located on the front side of a food package.

4.1. Traditional format nutrition labelling

The traditional format normally reports factual information about the nutrients found in a food item. The patterns/panels and nutrients included vary among countries or regions depending upon priority nutrition issues. A basic panel contains a nutrient declaration and supplementary information. For the nutrient declaration, essential key elements include amounts of energy, protein, carbohydrates, sugars, fat, saturated fat and sodium, as well as vitamins and minerals. Under certain circumstances, a nutrient may be declared differently. For example, most nutrition panels identify sodium (in milligrams) as a nutrient, except in the EU nutrition labelling panel that identifies it as a food item in terms of 'salt in grams'. Surprisingly, the explanation for this difference is for the same purpose, which is to avoid consumer confusion and for their better understanding. In fact, in the CODEX Guidelines on Nutrition Labelling, national authorities can choose to use the term 'salt' instead of the term 'sodium'. This issue highlights an interesting challenge for national authorities in developing educational strategies for public awareness, especially in how to understand and use nutritional labelling most effectively (**Figure 7**). Furthermore, the energy value and nutrient amounts can be expressed based on different reference units, i.e. per 100 g or 100 mL or per serving or per package, with percentages of nutrient reference values, particularly for vitamins and minerals. This situation might be due to different logics used during panel development. In fact, different reference units provide consumers with different views of information and usefulness. A reference unit of per 100 g or 100 ml compares nutritional properties between food products of the same category; whereas, a reference unit of per serving or per package is intended to inform consumers about the amounts of energy and nutrients obtained in one eating.

Some nutrition panels also contain information on the percentage that a certain amount of a consumed nutrient can fulfil in terms of daily requirements. Simply put for consumers, 'what percent of my daily requirements does this nutrient fulfil if consumed in a specific amount, recommended serving, or serving size?' This information is shown as percent nutrient reference values (%NRVs) or percent daily intake (%DI). Unfortunately, this information does not always appear in every panel format even though it is a useful guide for consumers.

Supplementary information located below the nutrition fact information usually consists of certain reference numbers on daily requirements of the nutrients which have been used for



Nutrition Facts
Serving Size 2/3 cup (55g)
Servings Per Container About 8

Amount Per Serving

Calories 230	Calories from Fat 72
	% Daily Value*
Total Fat 8g	**12%**
Saturated Fat 1g	**5%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 160mg	**7%**
Total Carbohydrate 37g	**12%**
Dietary Fiber 4g	**16%**
Sugars 1g	
Protein 3g	
Vitamin A	10%
Vitamin C	8%
Calcium	20%
Iron	45%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily value may be higher or lower depending on your calorie needs.

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

(a) USA

Energy	kJ/kcal
Fat	g
of which	g
- saturates,	g
- mono-unsaturates,	g
- polyunsaturates,	
Carbohydrate	g
of which	g
- sugars	g
- polyols,	g
- starch,	
Fibre	g
Protein	g
Salt	g
Vitamins and minerals	mg or µg

(b) EU

NUTRITION INFORMATION
Servings per package: (insert number of servings)
Serving size: g (or mL or other units as appropriate)

	Average Quantity per Serving	% Daily Intake* (per Serving)	Average Quantity per 100g(or 100mL)
Energy	kJ (Cal)	%	kJ (Cal)
Protein	g	%	g
Fat, total	g	%	g
– saturated	g	%	g
Carbohydrate	g	%	g
– sugars	g	%	g
Sodium	mg (mmol)	%	mg (mmol)
Vitamin C	mg	% RDI	mg
Calcium	mg	(per serving)	mg
		%	
		%	

*Percentage daily intakes are based on an average adult diet of 8700 kJ.

(c) Australia

NUTRITION INFORMATION
Servings per package: 25
Serving size: 15 g

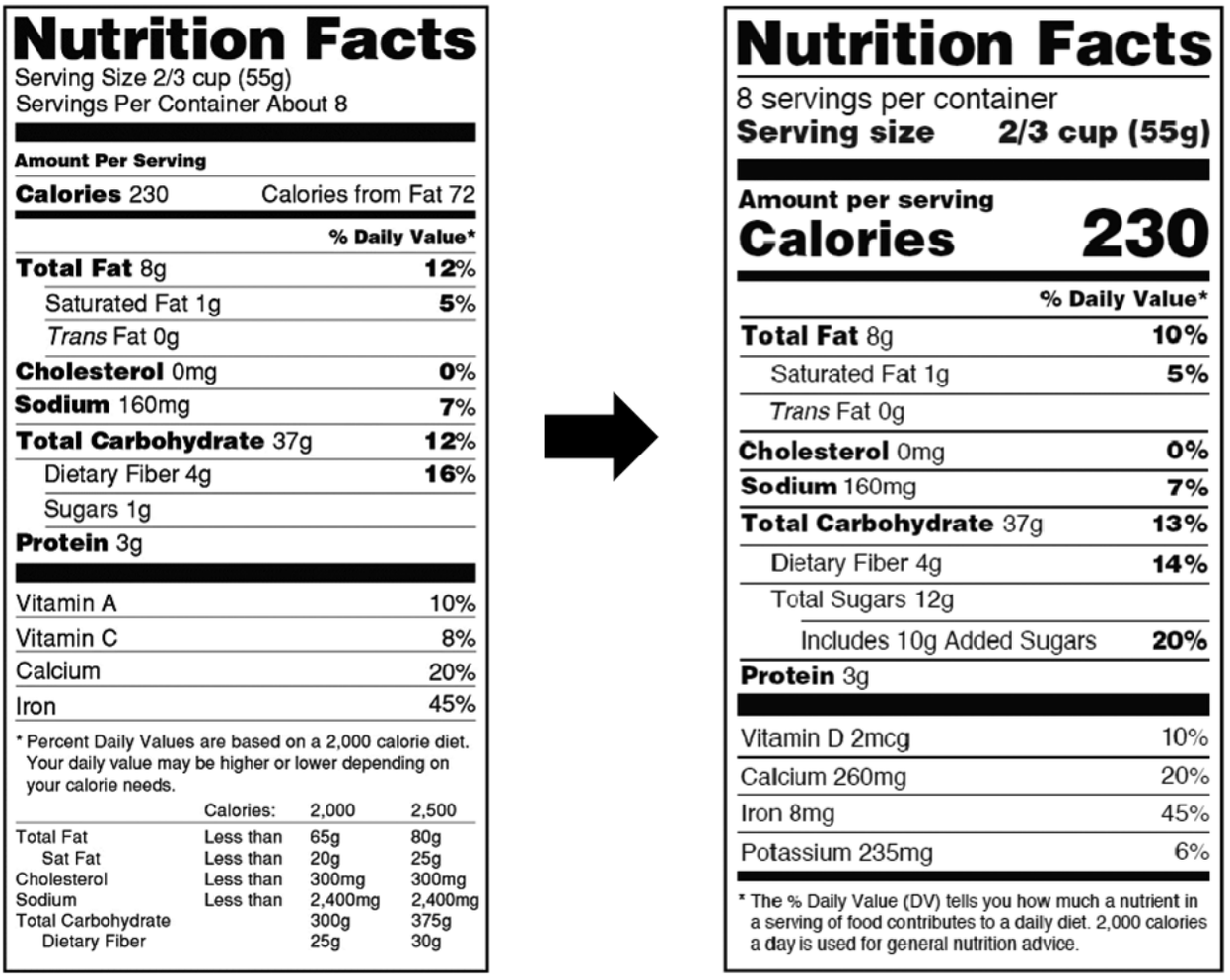
	Average Quantity per Serving	Average Quantity per 100 g
Energy	384 kJ	2560 kJ
Protein	4.4 g	29.3 g
Fat, total	7.6 g	50.7g
– saturated	1.5 g	10.0 g
Carbohydrate	2.0 g	13.3 g
– sugars	0.9 g	6.0 g
Sodium	41 mg	273 mg

Figure 7. Examples of nutrition labelling panels.

evaluating the percent contribution to needs of those nutrients. This supplementary information is optional under the CODEX and can be included if it can provide consumers with better information [11]. Recently, the US has changed its traditional nutrition labelling panel format to remove certain complicated information in the nutrient list [18] (**Figure 8**).

Nutrition labelling is regulated differently in different countries in terms of being mandatory or voluntary. Due to increasing concerns about overweight, obesity and NCDs, many countries are making nutrition labelling mandatory for all packaged food items. This stance is in line with the most current CODEX amendment to the Guidelines on Nutrition Labelling. This amendment recommends that nutrient declaration should be mandatory for all pre-packaged

http://dx.doi.org/10.5772/65728



Nutrition Facts
Serving Size 2/3 cup (55g)
Servings Per Container About 8

Amount Per Serving

Calories 230	Calories from Fat 72
	% Daily Value*
Total Fat 8g	**12%**
Saturated Fat 1g	**5%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 160mg	**7%**
Total Carbohydrate 37g	**12%**
Dietary Fiber 4g	**16%**
Sugars 1g	
Protein 3g	
Vitamin A	10%
Vitamin C	8%
Calcium	20%
Iron	45%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily value may be higher or lower depending on your calorie needs.

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Nutrition Facts
8 servings per container
Serving size **2/3 cup (55g)**

Amount per serving
Calories **230**

	% Daily Value*
Total Fat 8g	**10%**
Saturated Fat 1g	**5%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 160mg	**7%**
Total Carbohydrate 37g	**13%**
Dietary Fiber 4g	**14%**
Total Sugars 12g	
Includes 10g Added Sugars	**20%**
Protein 3g	
Vitamin D 2mcg	10%
Calcium 260mg	20%
Iron 8mg	45%
Potassium 235mg	6%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Figure 8. Comparison between original and new nutrition facts label of the United states *Source*:http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/LabelingNutrition/ucm385663.htm.

foods, although nutrition or health claims are not made [11, 19]. Such implementation can be found in the United States, Canada, Australia and New Zealand, amongst other countries, where all pre-packaged foods, except for some certain food items, are mandated for nutrition labelling. Under regulation (EU) No. 1169/2011 of the European Parliament and of the Council of 25 October 2011, nutrition labelling will be mandatory for all pre-packaged foods in European Union (EU) countries from December 13, 2016. In ASEAN countries, nutrition labelling is still voluntary unless a nutrition or health claim is made.

Traditional nutrition labelling panels are not effective nutrition education tools for general consumers, because consumers rarely use them to make informed food choices [20]. Cowburn and Stockley conducted a systematic review on consumer understanding and use of nutrition labelling. Their research showed that while a high number of consumers read nutrition label panels, in reality the effect of the panels on their food choice decisions was low. In particular, food panels that were more complex in terms of format hindered consumer understanding, interpretation and use of the panels [20]. Similarly, Hammond and co-workers conducted a systematic review of nutrition labels on packaged foods in seven developed and develop-

ing countries. They highlighted that while overall prevalence of nutrition label use amongst the general population in each country was generally high, it still varied across subgroups. However, in terms of understanding, many consumers had difficulty in interpreting the quantitative information due to reading frequency, level of education, nutrition knowledge and health status. Moreover, graphical formats were preferred, such as healthy symbols on front-of-pack (FOP) labels. Nevertheless, both systematic reviews concluded that nutrition labelling was a constructive and cost-effective intervention that can contribute to make informed food choices. They also recommended that governments should try to find the most appropriate and effective format that consumers can most easily access and understand [21]. Under these circumstances, national authorities and non-governmental organizations in many countries intend to simplify their current nutrition labelling panels into the easiest formats possible to increase their use and promote healthier food choices and eating habits.

4.2. From 'traditional' to 'graphical'

Although the number of persons affected by over-nutrition has grown, along with NCDS, few of the most recognized intervention strategies have included providing effective consumer education and creating a healthy food environment. Nonetheless, simplification of the traditional nutrition labelling panels has sparked the interest of many governments and non-governmental organizations. To reduce consumer confusion in using the panels, greater attention has been placed on those nutrients that have proven to be potential risk factors for NCDs and excluding other nutrients usually listed on traditional nutrition labelling panels. Emphasis is being placed on guiding consumers to make quicker, easier and more accurate buying decisions. Likewise, food industries must be inspired and have greater opportunities to develop products with better nutrition profiles and introduce them into the market at affordable prices for consumers. In terms of format, a large area is often times needed to display the traditional nutrition labelling panel that is on the back of a food package or back-of-pack (BOP), which hinders visibility and legibility. As an important consequence, the traditional format may not encourage food industries to reformulate their products to have better nutrient profiles. Consequently, governments and non-governmental organizations have been working towards simplified nutrition labelling to help consumers identify and make healthier food choices at a glance.

4.3. Graphical format nutrition labelling

Initial interest in simplified nutrition labelling emerged in the late 1960s and was first developed by a non-profit organization (the American Heart Association) in 1987, followed by a government sector (Swedish Food Administration) in 1989 in the form of heart check and green keyhole symbols, respectively (**Figure 9**). The simplified nutrition labelling panel was in a graphical format and located on the front of food packages or front-of-pack. The FOP nutrition labelling panel became interesting and friendly for consumers.

Different FOP nutrition labelling panels were later developed in many parts of the world and managed by different organizations, for example, food industries, government agencies, non-profit organizations, food retailers and non-industry experts. To reduce panel complexity,

http://dx.doi.org/10.5772/65728

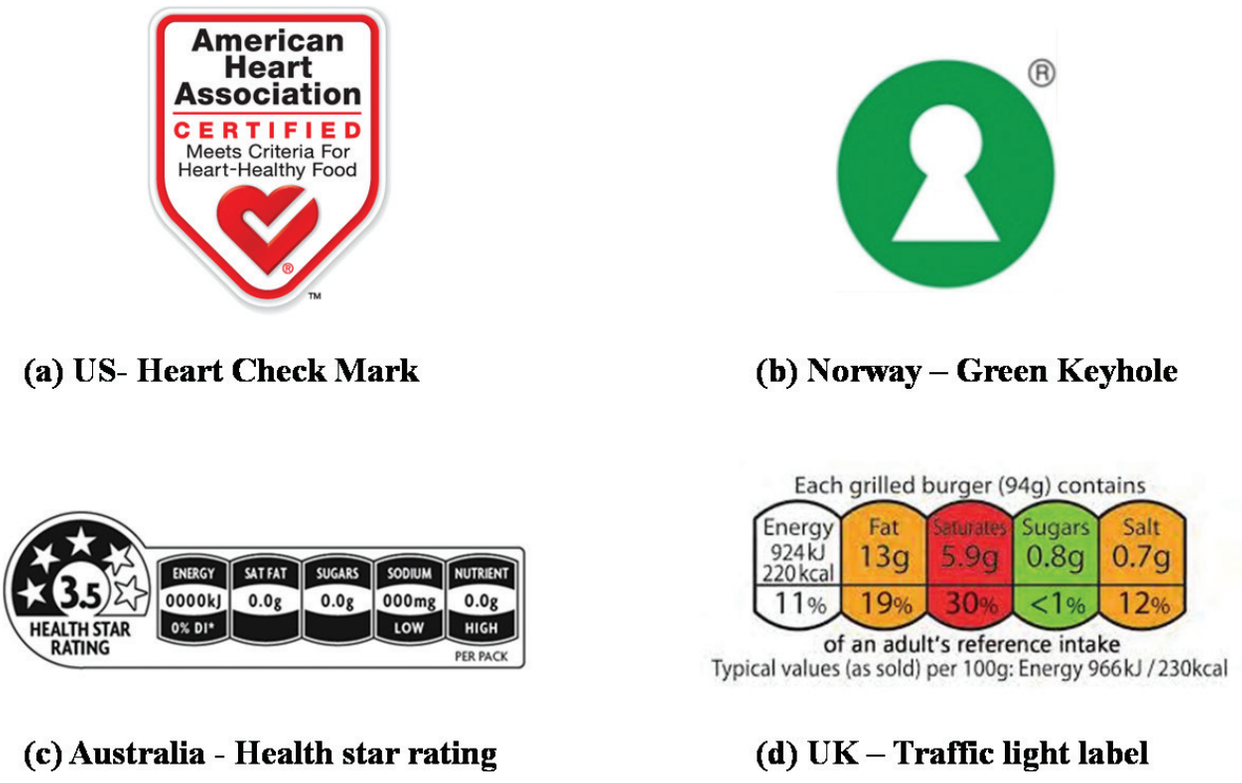


Figure 9. Examples of Front-of-Pack nutrition labelling panels. *Source*: (a) http://www.heart.org/HEARTORG/HealthyLiving/HeathyEating/Heart-CheckMarkCertification/Heart-Check-Mark-Certification_UCM_001179_SubHomePage.jsp?pid=7bc18bff66f34f909&pcid=MP; (b) http://www.livsmedelsverket.se/en/food-and-content/labelling/nyckelhalet/; (c) http://healthstarrating.gov.au/internet/healthstarrating/publishing.nsf/content/home; (d) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/300886/2902158_FoP_Nutrition_2014.pdf.

they contained information on 'undesirable' or 'disqualified' nutrients including energy, fat, saturated fat, *trans* fat, sugar and sodium. In some cases, more 'desirable' or 'qualified' nutrients were also included, such as dietary fibre or those nutrients that reduce the risks of NCDs. Van Der Bend et al. studied 40 FOP nutrition labelling panels in use around the world and they noted that undesirable nutrients as well as dietary fibre were the most common elements contained in the panels [22] (**Table 4**).

The standards for these nutrients in foods or food products can be interpreted based either on serving size, 100 g/ml, 100 kcal/kJ, daily value or a combination. Which standard is used depends upon the one that consumers best understand and/or the one that is most agreeable to the food industry. The design in terms of message, size, characteristics and panel location should be one that consumers can easily see, remember and understand. However, it should not make false or exaggerated claims about a product. The values used to establish criteria are normally based on internationally recognized health guidelines as well as the unique characteristics of food products. The established criteria usually are found as either independent qualifying/disqualifying thresholds or relative to what is found in commercial products. The different designs used in FOP nutrition labelling panels may require consumer input to determine what is absolutely (non-directive), partly (semi-directive) or not at all (directive) needed [22].

Nutrient	Percentage (%) use in FOP nutrition labelling panels
Dietary fibre	62.5
Protein	35
Calcium	30
Saturated fatty acids	75
Total sugar	62.5
Total fat	62.5
Sodium	62.5
Energy	52.5
Trans fatty acids	37.5
Cholesterol	30

Table 4. Percentages of nutrients normally found mentioning on the FOP nutrition labelling panels.

According to The Strategic Counsel, Toronto, Canada, at least 158 FOP nutrition labelling panels are being implemented and these are divisible into four types, nutrient specific, summary indicator, food group information and hybrids [23]. Examples of these FOP nutrition labelling panels are shown in **Table 5**.

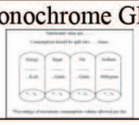
1. *Nutrient specific*: This type of FOP panel contains four to five types of nutrients that should be limited in order to reduce the risk of NCDs, that is energy, fat, saturated fat, sugar and sodium. The information shown is generally in amounts of nutrients per serving, which is not always the case and depending on a country's context. In some instances, per 100 g or 100 ml or per package are also used. Percentages of daily requirement or maximum consumption limits per day of the nutrients are additional information shown on these panels. The presentation pattern can be shown as a sequence of rows or as a pie chart. The pattern is presented either in monochrome or multi-chrome (normally consisting of three colours similar to a traffic light).

2. *Summary indicator*: A summary indicator is represented only by a symbol that may or may not imply good health. To have a summary indicator shown on the front of a food package, the nutrient profile of the food must pass the established nutrition standard for that food, usually through comparisons on the nature of such food or food product. The criteria mostly depend on the amount of undesirable nutrients removed, reduced or contained.

3. *Food group information*: This type of FOP nutrition labelling panel is based on the existence of certain food groups or food items that should be consumed in greater amounts to reduce the risk of NCDs. The terminologies used for identifying food items on the panel are normally similar to those recommended in a country's food-based dietary guidelines and aiming for better consumer understanding.

4. *Hybrids*: More than one type of FOP nutrition labelling panel can be shown on the same package, which should provide additional information on different aspects to increase

http://dx.doi.org/10.5772/65728

	Nutrient specific	Summary indicator	Food group information	Hybrids
Non-evaluative				
Nutrient	monochrome GDA 			
food group content			Food group information • My Pyramid  • "Great For You" icon (Walmart)  • whole grains council stamp 	
Evaluative or interpretative				
Ordinal rating scale		• Health Star Rating – Australia  • Nu Val 		
Classification	• Multichrome GDA  • Traffic light 			In affiliated with the Singapore HCS
Conclusive				
Qualifying or disqualifying threshold criteria		• Healthier Choice (Choices Program)  • Keyhole  • Healthier Choice (TH) 		• Health Star Rating – Australia  • Singaporean Healthier Choice Symbol 
Relative criteria		• Healthier Choice (TH) 		

Source: Van Der Bend et al. [22], www.healthierlogo.com.

Table 5. Examples of each type of FOP nutrition labelling panels..

consumer understanding. For example, a summary indicator panel provides information for purchasing decisions, while an additional nutrient specific type panel explains the beneficial nutrient profile of the product.

Within the same type of FOP nutrition labelling panel, messages can provide different levels of information. A deeper informative message should have a higher impact on consumer decision-making, especially for those with health concerns. However, such a message must be developed through a process of evaluation, interpretation and conclusion as provided by different sectors, that is government, NGOs, food businesses, consumer protection agency and academics.

The degree of informativeness can be ranked at three levels.

1. *Non-evaluative or non-directive*: The information shown on monochrome FOP nutrient specific and food group information panels are based on this level of informativeness. Fact-based information on nutritive values of the selected nutrients is shown. The input is only on selecting certain information from traditional BOP nutrition labelling panels and reporting it in a simplified format or indicating what beneficial natural food group the product contains. Consequently, all foods can have a monochrome nutrient specific type of FOP panel with no need for further screening or evaluation by any party, as long as a complete data set for the required nutrients exists. At this level of informativeness, a FOP nutrient specific panel is suitable for more knowledgeable consumers since there is limited guidance. Additional information, such as percent contribution to the recommended daily intake, may not be understandable by most consumers as well. For food group information panels, the food group that is recommended for greater consumption is already visible. Hence, it should be easy for consumers to make a decision.

2. *Evaluative or interpretative or semi-directive*: Nutrition criteria are normally developed for categories of foods based on the FAO/WHO recommendations for energy, protein and nutrient requirements and using the nutrition criteria of four to five undesirable nutrients for meals, snacks and beverages. The criteria are usually developed into three levels of risk classification for each nutrient of each food category, that is high risk, potentially high risk and low risk. The multi-chrome FOP nutrient specific type panel is an example of a product at this level of informativeness. The amount and percent recommended daily intake of nutrients are listed with the NCDs risk evaluation. The risk evaluation result is indicated as colours, and usually as traffic light colours where red, amber and green indicate high, potentially high and low risk, respectively. Consumers can classify a food or a food product as good or bad depending upon the numbers of red, amber and green colours presented. The FOP summary indicator panel at this level is being implemented in Australia and the USA. Australia's Star® and the United States' Nu Val® are good examples of the use of this level for ordinal rating, wherein the risk evaluation is presented as number of stars or a full score of 100, respectively. The more stars there are, or the higher the score, the healthier the products. The application of this level of informativeness, either in the FOP nutrient specific or summary indicator type, still requires consumers to make independent judgments.

http://dx.doi.org/10.5772/65728

3. *Conclusive or directive*: A holistic nutrition standard for each food or food product is developed at this level of informativeness in either a positive or negative direction with the aim of reducing the risks of NCDs. Similar to the evaluative and interpretative levels, development must involve academicians and stakeholders. However, the criteria implemented at this level must provide a clear judgment in terms of qualified/disqualified or pass/non-pass in order to allow the use of a specific symbol on a product's FOP. Normally, the nutrition standard is specifically developed for each food product with regard to its nature, which may be as a threshold value or ability to reduce the undesirable nutrient(s) associated with NCDs risk that are normally high in such food or food product. Criteria can be developed based on reference values found in food products of the same type or group that are available in the market. These can be single or multiple criteria depending on the nature of the product. In practice, the criteria can be ideal, but they must also be feasible for food industries. For example, the nutrition standard for fish sauce is <6000 mg of sodium per 100 ml, which is a 30% reduction from what is normally found in the market (9000 mg per 100 ml). The nutrition standard for beverages is <6% sugar, which is a 50% reduction from 12% in generally marketed beverages. Sodium and sugar represent single criterion that have been developed relative to commercial products. An example of multiple criteria is milk, wherein the nutrition standard includes no sugar added and <1.5% fat. These criteria are independently developed as threshold values. The input of this informativeness level results in products that are deemed to be nutritionally healthier than others of the same type or group that are available in the market. Only products that pass screening with their nutrition standards qualify for these specific symbols. Most summary indicator types are developed at this level of informativeness.

4.4. A note of caution

A simplified FOP nutrition labelling panel aims to ease the lives of consumers by providing decision-making guidance based on scientific evidence. However, consumers tend to interpret panels that contain higher levels of informativeness in terms of 'claims'. Consequently, the processes used for nutrition standard development, as well as consumer communication, must be conducted carefully and take into account the available international standard found in the Codex Alimentarius on nutrition and health claims. For example, the green colour on a multi-chrome FOP nutrient specific type panel can be understood as a 'nutrition claim'. An FOP summary indicator can be understood either as a nutrition or health claim in terms of its environmental factors. An FOP summary indicator with a description of a food category and dominate nutrient (either higher or lower) can be interpreted as a nutrition claim, while ones with no description can be understood either way. Take, for example, the first two symbols on the green key hole and heart check symbol FOP nutrition labelling panels. Even though these two different symbols might have been developed from the same criteria found in a nutrient profile, they may affect consumer recognition differently. Since the green keyhole symbol was issued by the government authority that controls food quality and safety, it may be interpreted by consumers as a nutrition or health claim. Consequently, it is necessary for the government or issuing organization to either provide adequate information that the symbol

has been issued based on the product's nutrient profile, not health impact, or indicate the FOP nutrition labelling panel is a hybrid type comprised of other types of FOP nutrition labelling, such as GDAs. Furthermore, consumers may interpret a symbol issued by a professional health association as a health claim. For the heart check symbol, the product might be interpreted in terms of lowering the risk for cardiovascular diseases. Consequently, harmonization of established standards with local and international standards and regulations should also be taken into consideration.

4.5. Outcome and expectation

While traditional BOP nutrition labelling panels are mandatory in most countries, the FOP nutrition labelling panels are implemented mainly on a voluntary basis. The exception is the monochrome Guideline Daily Amounts (GDAs) panel that is preferred by the food industry and has become mandated in some countries. After nutrition standards have been developed and accepted, the food industry is the first stakeholder that is actively involved. Products that have met their nutritional standards should be promoted first. Product development research should be performed continuously in order to offer more product choices in the market by changing composition and/or reformulating using new ingredients and/or replacers. In addition, new products with acceptable nutrient profiles can also be introduced into the market. **Figure 10** indicates the numbers of food products that have been sorted, reformulated and developed with regard to the Choice International® criteria.

Reduction in packaging size to fit with minimum serving size can also improve a product's nutrient profile as well as consumer behaviour. Consumers tend to eat a larger amount of food if that food is served/packaged in a larger serving size. To launch a qualified food

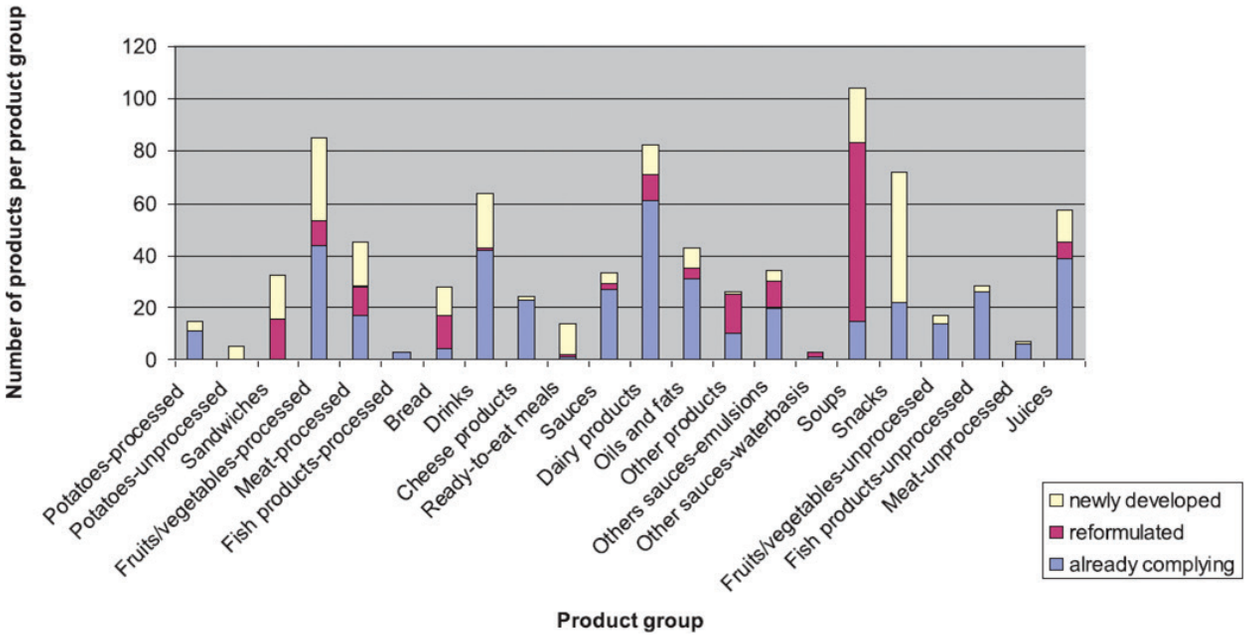


Figure 10. Total numbers of products that were newly developed, reformulated or already complaint with the Choice International® criteria (slide 26 Canada slide). *Source*: Ellis L Vyth et al. (2010) [24].

http://dx.doi.org/10.5772/65728

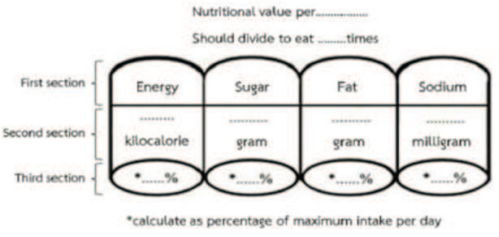
product (original, reformulated, newly developed) in the market, costs due to labelling changes is unavoidably increase. Hence, there must be a grace period for utilizing left-over packages and printing new ones. The concept used for advertising and promoting the FOP nutrition labelling panel must then include NCD risk, the purpose of which is for consumer education. For most consumers, sensory quality is an important issue and oftentimes more important than nutritional quality. The most conservative strategy is to improve the nutrient profile of a product but still maintain its original sensory quality. This may involve replacing normally-used ingredients with substitutes or replacers for salt, sugar or fat. Consumer behaviours may not change for the better if those undesirable nutrients are not replaced with acceptable ones. Since change in consumer eating behaviours towards better nutrition is the paramount goal, the promotion message sometimes must guide consumers to partly modify their sensory preference in order to gain better nutrition. However, this is a difficult process and takes time, but it must be urgently started. Marketing and logistics strategies are equally important as part of the promotion strategy, since the products must be widely available for consumers at affordable prices. If both main players—consumers and the food industry—satisfactorily respond to a program, the outcomes should have beneficial impacts for health and marketing.

Table 5 also indicates that external factors (i.e. community, culture) and internal factors (i.e. individual) can influence expected outcomes. Inputs from government and non-governmental agencies on several important issues, such as nutrition education, preventive medical care policy, support for nutritious food production and promotion in relationship to the food culture, are examples of external factors that can significantly influence to stakeholders. For consumers at the demand side, their buying decisions can also be influenced by individual factors, such as educational background, socioeconomic status, health status and awareness.

The program's outcomes should initially benefit consumers and food industries in terms of availability of nutritious foods in the market and increased product sales, respectively. In the long-term, it is expected that the information that is provided through the FOP nutrition labelling panel should serve as a nutrition education tool for changing consumers' eating behaviours, especially in terms of preference for undesirable nutrients.

A number of studies have evaluated the impacts of FOP nutrition labelling on consumer and industrial sides. Methodologies, such as self-reporting and focus groups, have been used to evaluate understanding and use of the FOP nutrition labelling panel among consumers in terms of their food purchasing decisions. Observational studies estimated the impact of FOP nutrition labelling panel on consumers' selection. Indicators, such as increased numbers of qualified product sales as well as reformulated and newly developed products in the market, were used to determine the impact of FOP nutrition labelling among industries. In addition, the impact of FOP nutrition labelling on nutrient intake and health outcomes can be evaluated from national food consumption and national nutrition surveys [25].

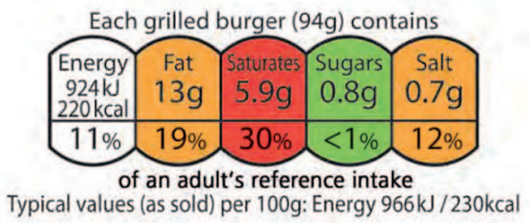
Many studies have shown that the FOP nutrition labelling panel has been quite helpful to consumers and their food choice decisions [25, 26]. Moreover, the simpler format for FOP nutrition labelling panels (e.g. Healthier Choice Tick, Smileys and Stars) is more effective than complex ones (e.g. Multiple Traffic Light, Wheel of Health, GDA scores), since consumers can more

1st Example: Thailand's Healthier Choices for Meal	
Character:	 Source: http://healthierlogo.com/
Criteria:	Based on scorings of 4 desirable nutrients: protein, fiber, calcium, and iron, and 4 undesirable nutrients: total fat, saturated fat, total sugar, and sodium. The score ranges from 0-5 (0 – worst to 5 – best) regarding the content of each nutrient per 100 kcal, in which the full score is 40. The qualifying thresholds are: (i) Energy per serving is 250-500 kcal, (ii) Score for each undesirable nutrient is > 0, and (iii) Total score is ≥ 20.
Type:	Summary indicator; Multiple criteria; **Informativeness:** Conclusive (Qualifying or disqualifying threshold)
Managing organization:	Government, Non-profit organization
2nd Example: Thailand's Monochrome Guideline Daily Amounts (GDAs)	
Character:	 Source: Attachment to the Announcement of the Ministry of Public Health (No. 374) B.E.2559 (2016) Re. Food products Required to bear Nutrition Labelling and energy value, sugar, fat, sodium on the labels of some kinds of foods Guideline Daily Amounts, GDA Labelling
Criteria:	The panel consists of energy value, contents of undesirable nutrients, and percentages of recommended daily intake (%DI) per package. This FOP nutrition labelling panel is presently applied in snack foods, chocolate and similar products, certain bakery products, instant noodles and porridge, and chilled and frozen ready-to-eat meals.
Type:	Nutrient specific; No specific criteria; **Informativeness**: Non-evaluative (Nutrient)
Managing organization:	Government

http://dx.doi.org/10.5772/65728

3rd Example: United Kingdom's Multichrome Guideline Daily Amounts

Character:



Source: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/300886/2902158_FoP_Nutrition_2014.pdf

Criteria:

The energy value and contents of undesirable nutrients as well as their percentages in terms of adult reference intake (%RI) are shown on the panel as per one serving. However, the evaluation using color coding is performed based on the criteria shown in the table below after the values have been converted into per 100 g or 100 ml.

Text	LOW	MEDIUM	HIGH	
Colour code	Green	Amber	red	
Fat	≤ 3.0g/100g	> 3.0g to ≤ 17.5g/100g	> 17.5g/100g	> 21g/portion
Saturates	≤ 1.5g/100g	> 1.5g to ≤ 5.0g/100g	> 5.0g/100g	> 6.0g/portion
(Total) Sugars	≤ 5.0g/100g	> 5.0g and ≤ 22.5g /100g	> 22.5g/100g	> 27g/portion
Salt	≤ 0.3g/100g	> 0.3g to ≤ 1.5g/100g	>1.5g/100g	>1.8g/portion

(Department of Health, the Food Standards Agency, and devolved administrations in Scotland, Northern Ireland and Wales in collaboration with the British Retail Consortium, 2013, p.14)

Type: Nutrient specific; Multiple criteria; **Informativeness:** Evaluative and Interpretative (classification)

Managing organization: Government

4th Example: Australia's Health Star Rating (HSR)

Character:

Source: http://healthstarrating.gov.au/internet/healthstarrating/publishing.nsf/content/home

Criteria:	Energy value, 3 undesirable nutrients, and 2 desirable nutrients (i.e., protein and fibre) indicated in one capsule as "nutrient" are shown on the panel as per package or per serving or per 100 g or 100 ml. However, the amounts are then converted into per 100 g or 100 ml and scored using established scoring criteria with a full score of 5.0 points. The calculated score is shown as numerically and in a darkened zone. The amount of nutrient per 100 g or 100 ml is evaluated for the "nutrient claim" message.
Type:	Hybrid; Multiple criteria; **Informativeness:** Evaluative and interpretative (Ordinal rating scale)
Managing organization:	Government
5th Example: USA's whole grains council stamp	
Character:	 (a) **100 % Stamp**  (b) **Basic Stamp** Source: http://wholegrainscouncil.org/whole-grain-stamp
Criteria:	**(a) 100% Stamp** – Product contains only whole grains of at least 16 g per serving. **(b) Basic stamp** - Product contain whole grain of at least 8 g per serving.
Type:	Food group information; Single criteria; **Informativeness**: Non-Evaluative (food group content)
Managing organization:	Non-government (Whole Grains Council)

Table 6. Examples of the implemented front- of pack nutrition labelling panels.

quickly select healthier food choices [27]. Furthermore, FOP nutrition labelling panels implemented by national authorities have more credibility. The wide variety of FOP nutrition labelling panels of different designs and criteria that are being implemented worldwide, however, can be confusing for consumers, which leads to misinterpretation and hinder their effectiveness [28]. Consequently, it has been suggested that a single format should be implemented. Before beginning the panel harmonization process, the use of a simple visual model, the so-called 'Funnel

Model' that was developed by Van Der Bend et al. can be effectively used to evaluate available FOP nutrition labelling panels on the market worldwide. The model aims to illustrate, describe and compare all existing FOP nutrient profiling systems based on qualifying and disqualifying ingredients, reference units, purposes of use, methodological approaches, types of organizations and directivity [22]. Moreover, it also provides an overview of the different characteristics of each FOP in use. The model then can be used as a tool for situation analysis and provide efficient information for establishing a single format of FOP nutrition labelling panel (**Table 6**).

4.6. Range of applications

The main purpose of FOP nutrition labelling panel is to enable consumers to select pre-packaged food products that have better nutrient profiles in reducing the risks of NCDs. Another indirect benefit, which should also be a main purpose, is to educate consumers and improve their daily eating behaviours. Industries can use established nutrition standards as one of the criteria for product development. Since NCDs have become a global nutrition challenge, international and national government agencies tend to implement certain strategies for controlling unhealthy food products in the market, especially those high in fat, sugar and sodium. High taxation for food products that contain excessive amounts of fat, sugar or sodium is one strategy that has been used in some countries. Policy-makers can use the standard in the FOP nutrition labelling panel as a guideline to impose higher taxes, such as sugar a tax on sugary drinks. Regarding WHO concerns on the marketing of foods and beverages to children, the FOP nutrition labelling panel can be used as a screening tool for foods and beverages to be sold in schools and areas nearby, as well as for advertisements aimed at children. Foods and beverages that pass the nutrition standard can be included in the country's FBDGs, which is the guideline for the general population. Moreover, the FOP nutrition labelling panel can also be used for product promotion in international trade, wherein a better nutrient profile can add value to exported products, especially since the panel has been mutually recognized.

Author details

Visith Chavasit[1]*, Wantanee Kriengsinyos[1], Mayuree Ditmetharoj[2], Manasuwee Phaichamanan[2], Kangsadan Singsoong[2], Prapaisri Sirichakwal[1] and Araya Rojjanawanicharkorn[2]

*Address all correspondence to: vchavasit@gmail.com

1 Institute of Nutrition, Mahidol University, Nakhonpathom, Thailand

2 Food and Drug Administration, Nonthaburi, Thailand

References

[1] Webb P. Nutrition and the Sustainable Development Goals: An opportunity for real progress. SCN NEWS. 2015; Nutrition and the post-2015 development agenda seizing the opportunity (41):11-19. Geneva, Switzerland: United Nations System Standing Committee on Nutrition; 2015.

[2] Barker DJP. Fetal growth and adult disease. BJOG: An International Journal of Obstetrics & Gynaecology. 1992;99(4):275–6.

[3] WHO. Global status report on noncommunicable diseases. Geneva, Switzerland: World Health Organization; 2014.

[4] WHO. Fact sheet: Noncommunicable Diseases. World Health Organization; 2015. Available from http://www.who.int/mediacentre/factsheets/fs355/en/

[5] Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet (London, England). 2012;380(9859):2224–60.

[6] WHO. Global Action Plan for the Prevention and Control of NCDs 2013–2020. Geneva, Switzerland: World Health Organization; 2013. 103 p.

[7] FAO. FAO's Role in Nutrition. 2016. Available from: http://www.fao.org/nutrition/en/

[8] Tontisirin K. Historical overview of food-based dietary guidelines. In FAO/WHO Technical Consultation on National Food-based Dietary Guidelines: Geneva, Switzerland: World Health Organization; 2006. pp. 7–8.

[9] IOM. How Should the Recommended Dietary Allowances Be Revised? Washington, DC: National Academies Press; 1994.

[10] IOM. Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids. Washington, DC: National Academies Press; 2002.

[11] Codex Alimentarius Commission. Codex Guidelines for Nutritional Labelling (CAC/GL 2-1985). Rome, Italy; 2013. Available from http://www.fao.org/ag/humannutrition/33309-01d4d1dd1abc825f0582d9e5a2eda4a74.pdf.

[12] WHO. WHO Technical Report Series No. 797. Geneva: World Health Organization; 1990.

[13] WHO. Diet, Nutrition and the Prevention of Chronic Diseases. Report of a Joint WHO/FAO Expert Consultation. Geneva, Switzerland: World Health Organization; 2003.

[14] USFDA. The FDA takes step to remove artificial trans fats in processed foods. 2015. Available from http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm451237.htm

[15] Gluckman PD, Hanson MA, Buklijas T. A conceptual framework for the developmental origins of health and disease. Journal of Developmental Origins of Health and Disease. 2010;1(01):6–18.

[16] Beaglehole R, Bonita R, Horton R, Adams C, Alleyne G, Asaria P, et al. Priority actions for the non-communicable disease crisis. The Lancet. 377(9775):1438-47.

[17] Hawkes C. 4-Government and voluntary policies on nutrition labelling: a global overview. In: Innovations in Food Labelling. Janice Albert, Ed. Cambridge: Woodhead Publishing; 2010. pp. 37–58.

[18] USFDA. Changes to the Nutrition Facts Label. In: USFDA, editor. 2016. Available from http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/LabelingNutrition/ucm385663.htm

[19] EUFIC. Global Update on Nutrition Labelling Brussels, Belgium: the European Food Information Council; 2015.

[20] Cowburn G, Stockley L. Consumer understanding and use of nutrition labelling: a systematic review. Public health nutrition. 2005;8(1):21–8. PubMed PMID: 15705241. eng.

[21] Campos S, Doxey J, Hammond D. Nutrition labels on pre-packaged foods: a systematic review. Public health nutrition. 2011;14(8):1496–506. PubMed PMID: 21241532.

[22] Van Der Bend D, Van Dieren J, Marques MDV, Wezenbeek NL, Kostareli N, Rodrigues PG, et al. A simple visual model to compare existing front-of-pack nutrient profiling schemes. European Journal of Food Research & Review. 2014;4(4):429.

[23] Schermel A, Emrich TE, Arcand J, Wong CL, L'Abbé MR. Nutrition marketing on processed food packages in Canada: 2010 Food Label Information Program. Applied Physiology, Nutrition, and Metabolism. 2013;38(6):666–72.

[24] Vyth EL, Steenhuis IH, Roodenburg AJ, Brug J, Seidell JC. Front-of-pack nutrition label stimulates healthier product development: a quantitative analysis. Int J Behav Nutr Phys Act. 2010 Sep 8;7:65. doi: 10.1186/1479-5868-7-65.

[25] Borgmeier I, Westenhoefer J. Impact of different food label formats on healthiness evaluation and food choice of consumers: a randomized-controlled study. BMC Public Health. 2009;9:184. PubMed PMID: PMC2702386.

[26] Sacks G, Rayner M, Swinburn B. Impact of front-of-pack 'traffic-light' nutrition labelling on consumer food purchases in the UK. Health Promotion International. 2009 December 1, 2009;24(4):344–52.

[27] Feunekes GI, Gortemaker IA, Willems AA, Lion R, van den Kommer M. Front-of-pack nutrition labelling: testing effectiveness of different nutrition labelling formats front-of-pack in four European countries. Appetite. 2008;50(1):57–70.

[28] Draper AK, Adamson AJ, Clegg S, Malam S, Rigg M, Duncan S. Front-of-pack nutrition labelling: are multiple formats a problem for consumers? The European Journal of Public Health. 2013;23(3):517–21.

IntechOpen