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The Growing Role of Front-of-Pack Nutrition Profile Labeling: A Consumer Perspective on Key Issues and Controversies

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Nutrition-related diseases, such as some cancers, heart diseases, and obesity, belong to the most challenging health concerns of our time. Communicating intuitive and simple nutrition information by means of front-of-pack (FOP) nutrition profile signpost labeling is increasingly seen as an essential tool in efforts to combat unhealthy food choices and improve public health. Consequently, much attention in policy and research is given to nutrient profiling methods and the determination of optimal nutrition criteria. Although consumer research on nutrition signpost labeling is now gradually appearing in the literature, the value and meaning of these labeling systems for consumers have received less attention. In the current debate a concise overview is lacking of the consumer perspective, including relevant psychological phenomena, in relation to much debated controversies surrounding these labels and their further development, such as the most effective type of signpost labeling system and varying stakeholder interests. Therefore, this paper aims to critically review the literature in the consumer domain of FOP nutrition labeling in order to illustrate the strengths and weaknesses of this form of nutrition education from a consumer perspective.

Keywords Nutrition signpost labeling, food labeling, nutrition information, traffic light system, Guidelines Daily Amounts (GDA)

INTRODUCTION

Nutrition-related diseases, such as obesity, heart disease, and diabetes, have risen at an worrying rate across the globe during the last decades (Muller-Riemenschneider et al., 2008). Given that the health of both children and adults is at stake, a need to act is felt by public health authorities (Gortmaker et al., 2011). Creating more supportive environments that encourage people to make healthful choices by means of nutrition education is seen as an important way to achieve this. In the 1980s and 1990s, nutrition education focused on dietary guidelines that showed which food groups should be eaten less (e.g., meats) or more (e.g., fruits and vegetables). The provision of detailed dietary information at the back of food packages (e.g., nutrition fact panels in the form of a table or a grid) started to appear on food packages at about the same time period and was expected to have long-term positive effects on consumers' food choices (Kozup et al., 2003). However, putting this general advice into practice appeared not to be straightforward for consumers. This information is less accessible and complicated to use in product comparisons. As many consumers nowadays focus less attention on food preparation, need of more intuitive systems was felt. As a result, the focus in the last decade has moved toward more product-oriented and practical tools to help people make better choices (Lobstein and Davies, 2009). Nutrition signpost labeling is seen as an important and practical tool to assist consumers when making food choices. For example, the World Health Organization (2004) considers nutrition labeling an essential part of its global strategy on diet, physical activity, and health. In particular, the focus has shifted toward the front of food package or shelf tag with simplified and visible summary information on nutritional quality; the so-called front-of-pack (FOP) nutrition label, or nutrition signpost label. Although FOP labels, logos, symbols, icons, or numeric panels to communicate healthfulness are not new (early developments started in the 1980s), most systems have been introduced during the last decade, and since

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then the number of products with FOP labeling has increased substantially and appears to be growing strongly (Lobstein and Davies, 2009; Bonsmann et al., 2010; Williams et al., 2010).

The underlying objectives of nutrition signpost labels are threefold. First, they should help consumers understand the relative nutritional quality of a food product either within or between product categories when in front of a supermarket shelf, and in this way improve their purchase decisions, diet, and health (Health Council of the Netherlands, 2008; Dagevos and Van Kleef, 2009; Lytton, 2010; Williams et al., 2010). This is essentially a key premise for signposting nutrition information and it is often stressed that these summary labels should be useful for consumers from various backgrounds in terms of literacy, education, and age (BEUC, 2006; Food Standards Agency (FSA), 2009). Second, the labels should encourage food manufacturers to develop healthier products by either reformulating their current products or developing new products with such a nutritional composition that this allows carrying a favorable nutrition label (Vyth et al., 2010a, 2010b; Sacks et al., 2011a, 20011b). Finally, FOP labels allow governments to influence public health in a non-enforcing, voluntary way, allowing consumers an informed choice (Cowburn and Stockley, 2005), and producers the freedom of producing what they want.

These high ambitions and expectations for typically small-sized labels on food packages have become a subject of debate and have received a great deal of attention in research and policymaking. Most papers in the area of nutrition signposting have presented the nutritional foundation of a single or multiple systems, or discuss nutritional criteria for licensing a particular label (Louie et al., 2008; Williams and Colyer, 2009; Gerrior, 2010). In comparison to the significant attention paid to consumer response to nutrition information in general and nutrient profiling methodologies (see Cowburn and Stockley, 2005; Grunert and Wills, 2007; Garsetti et al., 2007; Foltran et al., 2010 for excellent reviews on these topics), the consumer perspective received less consideration in the implementation and development of FOP nutrition label systems (Szanyi, 2010). Although consumer research on nutrition signpost labels is appearing increasingly in the literature (Kelly et al., 2009; Sacks et al., 2009), the "ideal" signposting scheme is typically discussed from a nutritional profiling perspective with the additional notice that it should be simple to use for consumers (Garsetti et al., 2007; Trichterborn and Harzer, 2007). The aim of this paper, therefore, is to critically review the literature in the consumer domain of FOP labeling to illustrate the strengths and weaknesses of this form of nutrition education from a consumer perspective. Although not exhaustive, numerous publications are reviewed to illustrate the various methodologies used and major studied themes in the FOP labeling field. To achieve this aim, our paper is structured along the classic phases of consumer decision-making models (i.e., awareness/attention, understanding and inferences, and use). In addition, we included sections on impact on consumer diet and health and on trust, transparency, and government enforcement. As a result, we included papers that included any methodology, but focused on one or more of these themes.

Section 2 describes the most important existing schemes and the underlying dimensions on which they vary. The dimensions on which nutrition signposting schemes differ have strong implications for consumer awareness and understanding (Sections 3 and 4). Signpost labeling has been initiated with the goal of improving consumers' diet and health. The existing evidence about the effectiveness of these schemes and the different types of research that examine this are discussed in Section 5. Moreover, signpost labeling is heavily debated among key stakeholders such as public authorities, consumer associations, and the food industry. The key issues regarding trust, transparency, and government enforcement are discussed in Section 6. We end with summarizing the key consumer issues that play a role in further development of these systems and how signposting schemes as policy measure relate to other policy measures. Taken together, if we have more insight in the consumer psychological issues surrounding the current debates, we can better shape optimal nutrition signposting schemes as a means to improve consumers' dietary choices and health.

DIMENSIONS ON WHICH NUTRITION LABELING SCHEMES DIFFER

Signposting labels are based on the nutritional features of a food and aim to assist consumers in judging the nutritional quality of a particular food. Nutrient profiling methodologies have been developed to rank the healthiness of foods based on their nutrition composition. These scoring mechanisms are based on both scientific and pragmatic principles (Townsend, 2010). The resulting ranking is then used not only for signpost labels but also for various other purposes, such as guidance in the development of new products (Trichterborn and Harzer, 2007) and regulatory purposes such as the assessment of suitability of foods to carry health claims or to be advertised to children (Williams and Colyer, 2009). They can also be used to regulate the availability of certain foods at public institutions such as schools, hospitals, and prisons (Sacks et al., 2011a, 20011b). Using nutrient profiling, a large variety of systems have been developed and implemented by a variety of organizations such as grocery stores, non-profit organizations, food manufacturers, or combination of these.

Basically, the current systems can be classified into the following two approaches: criteria-based and fact-based (Pereira, 2010; Schor et al., 2010). First, fact-based nutrition signposting systems primarily restate quantitative nutrition information in a more concise way than the traditional back-of-pack nutrition label. An example is the numerical- or percentage-based representation of the Guidelines Daily Amounts (GDA). The GDA system displays the proportion of key food components as a percentage of daily intake by an adult of an average weight and level of activity. This type of labeling is not new, as in

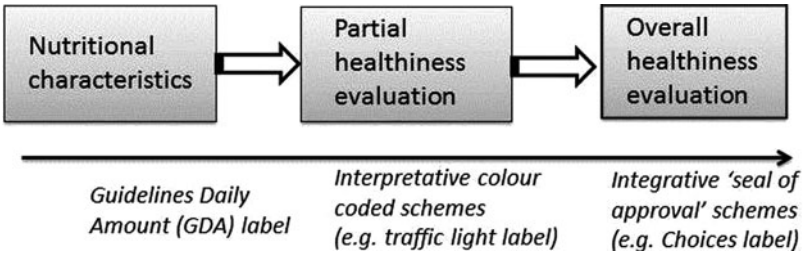

Figure 1 Nutrition profile schemes differ to the extent to which they provide healthiness evaluations (none, partial, or overall).

the United States the percentage daily value has been included in the nutrition fact panel for a long time (Louie et al., 2008). Sometimes only calorie information is presented, but often information about total fat, saturated fat, sugar, sodium, and sometimes fibers is also provided. The last one is the only nutrient for which consumption has to be encouraged. GDAs are not targets for individuals but can be used to get a rough idea of the ceiling of these nutrients in a typical diet (Denny, 2006). The GDA system has been adopted by various food companies, such as Tesco (UK), Kellogg's, Danone, and Kraft.

Second, criteria-based nutrition signposting systems categorize foods according to a set of criteria. These criteria can be categorical or continuous (Foltran et al., 2010). The nutrition criteria for receiving a label are specific per product category in categorical systems. Continuous models, in contrast, use the same nutrition criteria across product categories. They are also called "across the board" models and seem to be more frequent than food category-based schemes (Garsetti et al., 2007). They operate by calculating a score for each food, regardless of the type of product category that can then be used to rank foods (Foltran et al., 2010). An example of the continuous system is the NuVal nutritional scoring system that uses a mathematical algorithm to compare individual products and rate them on a scale of 1–100 and post this information on supermarket shelves (Kondro, 2008). Within criteria-based schemes, the *character* of the label is another key dimension on which schemes differ (Lytton, 2010), that is, some schemes provide information that only stresses positive aspects of a product. This is often the case with schemes based on a categorical approach which identifies foods as "healthy" or "good for you" on the basis of an identified standard such as maximum levels of (among others) fat, added sugar, and sodium (Townsend, 2010). This, in turn, leads to a simple graphic such as a "seal of approval," "health tick," "quality stamp," or label on products that meet the evaluation criteria set by the organization (Butler, 2010). Examples include the Swedish Green Keyhole system (Larsson et al., 1999), the Smart Choices label (Lupton et al., 2010), the Choices program that can be found in over 50 countries (Dotsch-Klerk and Jansen, 2008; Roodenburg et al., 2009), and PepsiCo's Smart Spot (Yach et al., 2007). Another example of a scheme that only stresses the positive aspects of a product is the Guiding Stars system of the US retailer Hannaford (Sutherland et al., 2010). This system works with three stars, with one star representing good nutritional value, two stars –representing better, and three stars –for the best nutritional value per 100 calories. Schemes that solely stress negative aspects of a product are rare, although an example is the Finnish "high salt content" warning (Pietinen et al, 2008). A key example of a system that presents both negative and positive information and is based on a continuous model is the interpretative color-coded scheme, such as the traffic light system (TLS). The most well known TLS is based on the UK's FSA model that calculates scores for all foods using the same set of nutrients and mathematical formulae (Foltran et al., 2010). After that, score threshold criteria are set. TLS is characterized by indicating the healthiness of a food by giving a green, amber, or red symbol. For example, a red light shows that the product contains a high level of one of the four key ingredients, i.e., fat, sugar, saturated fats, and salt and hence should be eaten occasionally or in smaller amounts. More green lights on a product indicate healthier choice. In the United Kingdom, the FSA has voluntarily adopted the traffic light system, although in practice, GDA labeling is more widely adopted than the TLS (Van Camp et al., 2010).

Another relevant dimension on which nutrition profile schemes differ is the degree of aggregation of nutrition information (Lytton, 2010). Some schemes present a healthiness evaluation that is partial (i.e., evaluation of particular nutrients), while others give one summary healthiness rating or label for a food product (e.g., Choices label). Figure 1 gives an overview of this dimension.

Other dimensions include the choice between qualifying and disqualifying nutrients and the choice for a reference base (e.g., per 100 g/ml/kcal, serving) (Drewnowski, 2007; Verhagen and Van den Berg, 2008; Möser et al., 2010). In general, the various dimensions on which the schemes differ are not independent from each other and combinations of different approaches have been suggested. For example, GDAs could be combined with color-coded information on whether the percentages are favorable, neutral, or unfavorable (Health Council of the Netherlands, 2008; Verhagen and Van den Berg, 2008; Lobstein and Davies, 2009).

CONSUMER AWARENESS AND ATTENTION

To begin with, nutrition signposting labels can only have an effect if consumers are exposed to them. Exposure can be intentional when consumers purposefully search for information,

or accidental when consumers unexpectedly encounter it (Peter et al., 1999). Attention is influenced by both bottom-up factors in the environment and top-down factors in the viewer (such as motivation and time constraints of consumer). Bottom-up factors, such as the type of label or its position on pack, influence the likelihood that a label becomes salient and captures attention (Bialkova and Van Trijp, 2010; Van Herpen and Van Trijp, 2011). Only 10% of Americans report looking for a health symbol or icon on food packages (Schor et al., 2010). When walking into a grocery store, consumers are confronted with an abundant number of choices. Consumers are often too rushed to intentionally search for nutrition information in distracting, noisy purchase environments such as a supermarket. People are more likely to look for a label when they purchase a food for the first time, or when they are shopping for children or are trying to lose weight and control the intake of a particular nutrient such as sugar or fat (Food Standards Agency (FSA), 2009; Malam et al., 2009; Schor et al., 2010; Vyth et al., 2010a, 2010b). Due to their limited cognitive abilities, consumer attention is focused on what matters most, which is complicated by the often occurring time pressure when trading off price, brand, convenience, and taste in a real-life choice context (Szanyi, 2010). Food labeling operates within this context, and lack of attention is an important problem in relation to the use of nutrition labels (Van Trijp, 2009). What complicates a label getting noticed is that some labels can only be found on foods that meet specified nutritional criteria or are only assigned to a group of brands while other schemes cover all foods in a supermarket. This is for example the case with "health mark" nutrition signpost systems. For consumers, this implies that not noticing a label can mean two things: (1) the product did not qualify for the label as it has (relatively) low nutritional value, or (2) the product or brand is not part of the signposting scheme system. For example, loose fresh fruit and vegetables are often not included in a system (Lobstein and Davies, 2009). Consumers tend to overlook non-occurrences even though such a non-event (for example, no Choices label on a food package) may have implications for health. This phenomenon is known as the feature-positive effect (Kardes et al., 1990). This suggests that seeing a label is more informative than not seeing a label.

Given that there is a label on the food package, the question furthermore arises whether consumers see labels in the midst of other information on the package. Some studies identified factors that facilitate rapid and efficient label identification. A key characteristic of almost all FOP labels is that they use graphic and symbolic elements to convey their judgment. Pictorial elements on a package are recognized better than words, particularly by low-literate consumers (Viswanathan et al., 2009). This resembles earlier findings from research on health claims that showed that short claims combining text and graphics using colors are most effective (Geiger, 1998). In addition, the use of bold text, colors, and familiar words, such as calories instead of joules, has also been found to be better (Drichoutis et al., 2006; Ranilović and Barić, 2011). Compared with a more traditional nutrition table, a traffic light label or health mark label is more likely to receive attention and enhance healthy product choices even when consumers are put under time pressure (Van Herpen and Van Trijp, 2011). A recent experimental study on what nutrition label characteristics attract consumer attention found that display size (better attention with doubled display size), position of the label on the front of the pack, color scheme (better attention with monochromatic than polychromatic colors), and familiarity with the label system (a repetition benefit when the same label is used in consecutive exposures) were the key determinants of attention to labels (Bialkova and Van Trijp, 2010). This implies that nutrition labels should be printed on consistent locations on the packages and be uniform in terms of size and colors so that consumers can easily find them.

UNDERSTANDING AND (MIS)INTERPRETATION

Once consumers are exposed to FOP labels, accidentally or through search, the interpretation and comprehension process begins. Comprehension is a prerequisite for correct use of labels and a key cognitive process in decision-making. Although FOP labeling is developed to overcome the difficulties of detailed (back of pack) nutrition information, there is still left to interpret and make sense of the information (see Table 1).

Various studies have shown that individual difference variables, such as nutrition knowledge and health status, influence the effects of nutrition information (Moorman, 1990, 2004; Drichoutis et al., 2005). A study that looked specifically at FOP labels in the United Kingdom found that older adults (over 65-year old), people with lower levels of education, and those from lower social classes are less likely to be able to accurately interpret the labels. Minority ethnic groups also have difficulty in interpreting them (Malam et al., 2009).

It is often stressed that the best understandable FOP label is a simple label. When asked for their opinion, consumers express a preference for simple and easy to understand label (Feunekes et al., 2008; Möser et al., 2010). A "seal of approval"-type label is particularly promoted for its simplicity because it minimizes consumer effort, and in this way act as a cue to reduce complexity (Andrews et al., 2011). Consumer research on the differences between the systems, however, shows mixed results. A cross-European study comparing various schemes found that "seal of approval" labels were easier to understand according to consumers, although results showed no difference in objective understanding (correctly assessing information at label and classifying food accordingly) (Feunekes et al., 2008). Other studies show that particularly a traffic light system helps consumers to pick healthier choices (Kelly et al., 2009; Balcombe et al., 2010). Traffic light labels are more or less self-explanatory in that they make judgment for consumers in terms of good, moderate, or bad choices. Eye tracking research showed that traffic light systems were better able to guide consumer attention to important nutrients and judge the healthiness of a food compared with standard back-of-pack labels (Jones and Richardson, 2007). An experimental study in Australia (Kelly et al., 2009)

Table 1 Three key signposting FOP nutrition label systems: nutrient profiling approach, examples, nature of evaluative judgment presented, and implications for consumer understanding

	Criteria-based signposting schemes		Fact-based signposting schemes
	Integrative "seal of approval" schemes	Interpretive color-coded schemes	Guidelines daily amounts (GDA)
Nutrient profiling approach	"Seal of approval" or mark conveys that a food satisfies some minimum standard nutritional quality. Underlying nutrient criteria are typically food category-based.	Color rating of individual nutrients of a food (low, medium, high) based on threshold criteria (e.g., low in sodium). Non-food category depended: in principle, label can be found on all the products across product categories.	Small table or grid showing summary of amount of energy and nutrients and the percentage of daily intake according to guidelines. Non-food category depended: in principle, label can be found on all products across product categories.
Examples	Swedish Green Keyhole scheme (Larsson and Lissner, 1996), choices label, sensible solution (kraft), pick the tick (Young and Swinburn, 2002).	Traffic light systems, such as the one of the Food Safety Association or Wheel of Health label of UK Retailer Sainsbury	GDA label, General Mills' Nutrition Highlights Panel
Nature of evaluative judgment presented	Provides positive evaluative judgment: a label indicates that product is entitled to carry a label. Does not indicate whether a product is low or high in particular unhealthy or healthy nutrients.	Provides both positive and negative evaluative judgment: a label indicates whether a product is low or high in particular unhealthy or healthy nutrients.	No evaluative judgment is presented, only suggested ceilings for energy and key nutrients. Provides detailed "factual" information on both healthy and unhealthy nutrients.
Implications for consumer understanding	• As label is only put on relatively healthy products, consumers must be able to detect the absence of label and interpret this correctly. • Requires less consumer interpretation and nutrition knowledge. • May lead to overgeneralization of healthiness. • Foods with label are comparatively better, but this could be interpreted as better in absolute sense and a valuable part of a healthy diet. • To be evaluated relative to other foods in the same food category, but it may be unclear which foods these are, as some foods are not easily categorized.	• Requires less consumer interpretation and nutrition knowledge: use of familiar traffic light associations enhances understanding. • Some foods that are typically perceived as healthy will receive a red light (e.g., cheese). • Confusion in case product carries similar number of green and red lights.	• Provides detailed and factual information. • Requires considerable consumer interpretation and nutrition knowledge: no help on relative healthiness. • Unclear which nutrients are to be restricted and which to be encouraged. • Consumers may have difficulty in understanding energy needs and individual differences. • Not useful when choosing foods for children or other special groups, as intake approach is based on typical female diet.

found that traffic light systems are more effective in assisting consumers to identify healthier choices than GDA systems. Traffic light foods are ranked on an absolute scale and not relative to each other, which means that consumers are less likely to be influenced by surrounding foods (Szanyi, 2010). A GDA label does not give a clear evaluative judgment regarding the nutritional quality of food (see Table 1), rather, such labels require some efforts from consumers in forming a healthiness judgment. Consequently, this results in an average additional 10 seconds needed for consumers to evaluate foods with GDA scores compared with foods with a "seal of approval" mark (Feunekes et al., 2008). GDA labels do however present some background information (i.e., ceilings for intake) that may help consumers to interpret the information and makes it less necessary to rely on previous knowledge or comparison with other products. These benchmarks assist consumers to place a product in the context of their total diet. However, consumers must "mentally" keep track of other foods consumed throughout the day in order not to overconsume "negative" nutrients, such as fat, and achieve daily targets such as fibers. They must also consider how their individual needs differ from the needs of an average adult male/female (Louie et al., 2008; Magnusson, 2010). Moreover, the system includes both positive (fiber) and negative nutrients, which makes it rather complex. Most respondents in a recent study however had a good understanding of the GDA concept and could apply the figures in a correct way (Grunert et al., 2010a). For example, most consumers could correctly identify the healthier products when asked to compare two products on overall healthiness with a GDA label as being the only information available. There were differences across countries, however, regarding the understanding of GDA labels; the understanding was good in the United Kingdom, Sweden, and Germany, more limited in Hungary and Poland, and relatively low in France.

In general, consumers, as well as researchers and policy makers, feel that health and nutrition information is often conflicting and confusing (Schor et al., 2010). The UK research confirms this as it shows that the coexistence of a range of labels in the market place creates considerable frustration and difficulty in comprehension for shoppers (Food Standards Agency (FSA), 2009). Deeper and more elaborate comprehension often produces inferences, which are beliefs that are not based on information directly presented in the environment. These are

Table 2 Potential misinterpretations that might occur with FOP nutrition label systems in general

Potential misinterpretation	Example	Key references
Unclear whether food producer makes use of nutrition FOP labeling system.	Consumer may think that a food without a label can be relatively unhealthy, but it could also be that the food producer does not make use of the label system.	—
Unclear underlying criteria of label, such as whether information refers to a single portion size or 100 grams of product, or for whom label is intended.	Consumer may think that a particular label is only meant for people with a particular disease or diet.	Scott and Worsley (1994); Van Kleef et al. (2008); Grunert et al. (2010a, 2010b)
Dichotomous thinking.	Consumer may oversimplify the relative healthiness of foods by categorizing them into either good or bad foods.	American Dietetic Association (2007); Andrews et al. (2011)
Unclear whether label compares products across or within food categories.	Consumers might incorrectly assume that food with FOP label is healthier in absolute sense instead of relative in a particular category.	Higginson et al. (2002a); Feunekes et al. (2008)
Incorrect inferences regarding the healthiness, satiation, or taste of food with FOP label (e.g., health halo effect).	FOP labels may influence how much a consumer infers to be a reasonable amount to eat, and how much pleasure and guilt is felt after eating that amount. Healthy could also be associated with a less tasty or satiating food.	Aaron et al. (1994); Wansink and Chandon (2006)
Anchoring effect.	Too strong reliance on one piece of nutritional information in making decisions such as familiar nutrients.	Szanyi (2010); Hoefkens et al. (2011)

heavily influenced by consumer knowledge that is activated during comprehension (Peter and Olson, 1994). Consumers can make interferences from small amount of information. For example, some consumers might infer that a food is healthy because the advertisement emphasizes the naturalness of that product.

Various types of misinterpretations may occur with nutrition labels (see Table 2). It may be unclear that a particular label is intended for what type of consumers. For example, this happened to the National Heart Foundation label, about which 20–30% of the survey respondents thought that the presented information was intended for people with a heart disease (Scott and Worsley, 1994). Other important misconceptions about FOP labels tend to relate to whether the food producer makes use of a nutrition signposting system and whether the information refers to a single portion size or 100 grams of the product (Van Kleef et al., 2008; Grunert et al., 2010b).

Most concerns about misinterpretations regarding the actual healthiness of a food are related to "seal of approval" systems, such as the Choices label. These labels can only be found on relatively healthy foods within a specific product category and in this way they provide a positive information cue. These labels have been criticized for creating a misleading contrast between good and bad foods and thus do not allow consumers to distinguish graduations of relative healthiness (Butler, 2010). This may lead to dichotomous thinking, a thinking style that abandons more complex decision options or rules. Such oversimplification may promote unhealthy food choices and encourage overconsumption (American Dietetic Association, 2007). There is a research that supports this concern. Andrews and colleagues (2011) compared the effects of a "seal of approval" label with a combined traffic light–GDA label and a no FOP label condition in a between-subjects experiment. They found that a "seal of approval" might act as an implicit health claim as consumers perceive a product with such a label as healthier than a product with either the traffic light–GDA label or no label. Steenhuis and colleagues (2010) similarly found that chocolate cake was perceived as less unhealthy with Choices label compared with no such label. Nevertheless, no changes were observed in the amount of chocolate mousse cake consumed with or without a Choices label. Other types of FOP labels may also be vulnerable to this contrast effect. For example, Grunert and colleagues (2010b) found a tendency of consumers to over interpret the severity of amber color, and especially red colors, of traffic light labels as they believed that the products with a red light should not be eaten, while the FSA definition is that it is fine to have the product occasionally as a treat.

There is also the concern that nutrition information on packages makes people vulnerable to halo effects. Classic "halo effect" studies showed that if a person is judged to be performing well on one aspect, this positive evaluation extends to other aspects as well, even though these aspects may be unrelated (Nisbett and Wilson, 1977; Kahneman, 2011). For example, nutrition labels may influence how much a person infers to be a reasonable amount to eat, and how much consumption pleasure and guilt feeling a person anticipates by eating that amount (Aaron et al., 1994; Wansink and Chandon, 2006). FOP labels may bias evaluations of other product qualities, as has been found in the case of health (Roe et al., 1999) and nutrient content (Andrews et al., 1998; Geyskens et al., 2007) claims. Provision of energy or fat content of a food may lead consumers to overconsumption (Wansink and Chandon, 2006). Similar results were found with regard to how much a consumer ordered and ate in restaurants they perceived as healthier versus less healthy (Chandon

and Wansink, 2007). Likewise, exposure to health primes (e.g., words such as diet and fiber) increases the amount of low-fat chips consumed (Geyskens et al., 2007). This is because these primes led people believe that low-fat chips are healthier than these actually are and that they are closer to their ideal weight. Consumers furthermore tend to believe that eating healthy foods in addition to unhealthy ones can decrease a meal's calorie content (Chernev, 2010). Another potential reason for the overestimation of healthiness is that consumers particularly use FOP labels to make comparisons between different versions of the same type of product. So they look for the best yogurts within the entire category of yogurt products (Malam et al., 2009; Grunert et al., 2010b). Research on traditional nutrition label use shows similar results in that consumers make comparisons within a category of products (Higginson et al., 2002a). Nevertheless, a cross-European study found that consumers think that nutrition labels compare products across food products rather than between products within one category (Feunekes et al., 2008). This would imply that consumers assume that foods with a "seal of approval" are preferable in absolute sense and not in relative sense within a particular category. Closely related to health halos is the "unhealthy = tasty intuition" (Raghunathan et al., 2006), which can also lead to inappropriate generalizations. Indicating foods as healthy reduces consumers' taste expectations, experience, and even expected satiation (Aaron et al., 1994). For the Choices label, it was found that the higher people rated the enjoyment of the taste of food in their grocery cart, the fewer products with this label were actually bought (Vyth et al., 2010b).

The anchoring effect may also be at work in consumers' mind while interpreting nutrition information (Szanyi, 2010). Individuals evaluate options based on the surrounding information, and in doing this they may rely strongly on one piece of information for making a decision (Wilson et al., 1996), which is not desirable from a nutritional perspective (Brownawell and Falk, 2010). For food choices, the focus is typically on familiar nutrients, such as the declared *presence* of protein, fiber, calcium, and vitamin C and the total *absence* of fat and sodium. Saturated fat, fiber, iron, vitamin A, and sodium are examples of nutrients that are little or not taken into consideration (Higginson et al., 2002b; Drewnowski et al., 2010; Schor et al., 2010). Consumers, and mostly females, are most concerned about fat and energy information (Drichoutis et al., 2005; Balcombe et al., 2010; Ranilović and Barić, 2011). A recent pan-European survey (Hoefkens et al., 2011) found that qualifying nutrients (fiber, vitamins/minerals) were more important for food choice than disqualifying nutrients. Understanding daily caloric needs and appropriate portion size is very hard for consumers (Wansink and Van Ittersum, 2007). Calories displayed on a food package may therefore become the focal point of attention and may lead people to choose a food that scores relatively good on calories relative to other values even in cases in which the difference is negligible, such as 10 kcal difference (Szanyi, 2010). They may also think that higher calorie counts mean lower nutritional value (Szanyi, 2010), which is not necessarily true.

USE IN STORES AND IMPACT ON CONSUMER DIET AND HEALTH

According to what consumers claim themselves, health is one of their key choice criteria underlying food decisions, and FOP labels are preferred as an aid to simplify healthy food choices (Lando and Labiner-Wolfe, 2007; Verbeke, 2008; Schor et al., 2010). However, studies in which consumers are unobtrusively observed to examine label use typically reveal generally low levels of use (Rayner et al., 2001). Women, people having more time for grocery shopping, and those who are more concerned about nutrition are more likely to use nutrition labels (Drichoutis et al., 2006). In a study on the use and understanding of nutrition information on food labels in six European countries, shoppers were observed and interviewed in stores while shopping. Of all the shoppers observed, 16.8% did look for nutrition information (Grunert et al., 2010a). In the United Kingdom, 27% of the shoppers looked for nutrition information on food labels (Grunert et al., 2010b). In a study where researchers had a look at the content of the grocery carts after checking out, 18% of the purchased products had a label, although consumers often buy label products unintentionally (Vyth et al., 2010a, 2010b). Much of the research on labels has been conducted in laboratory settings, which do not accurately simulate the real-life shopping environment in which people make their choices. Almost all studies rely on self-reported use, which makes it likely that people over report their use of labels (Cowburn and Stockley, 2005; Grunert and Wills, 2007; Malam et al., 2009). Self-reported measures are potentially biased because consumers may give socially desirable answers.

Whether consumers actually use FOP nutrition labels has been examined by analyzing sales data (e.g., Van 't Riet, 2013). By analyzing purchasing data over a period of two years, the Guiding Star systems showed significant but small changes in food purchasing immediately after implementation, and these changes continued to be significant even after two years (Sutherland et al., 2010). In 2006, 24.5% of the items purchased earned a star rating, this proportion increased to 24.98% and 25.89% in the following first and second years.

Sacks and colleagues (2009) examined sales data from a major UK retailer in 2007. Analysis of the sandwiches and ready meals categories showed no discernable effects on the relative healthiness of consumer purchases. This study had a short-term focus in that it studied the sales four weeks before and after the introduction of traffic light labels. The authors argued, however, that purchase patterns might change after this short time period if the labeling would cover a wider range of products. Based on another experimental study among more than 400 shoppers, various nutrition labels did not influence food choices and consumption decisions (Borgmeier and Westenhoefer, 2009). A randomized controlled trial in 25 work site cafeterias in the Netherlands investigated the influence of labeling foods with the Choices nutrition label. No nutritionally meaningful interventional effects were observed on the sales of sandwiches, soups, snacks, fruit, and salads (Vyth et al., 2011a, 2011b). Another

field experiment in a Dutch cinema showed no effects of caloric GDA labeling on soft drink intake (Vermeer et al., 2011).

To understand whether nutrition signposting labels improve the diet quality of consumers, it would be necessary to examine actual changes in health status by way of randomized controlled trials, including biomarkers and medical records. A fundamental problem that limits research in this area is that reduced morbidity and mortality may take a decade or more to achieve (Townsend, 2010). Another major obstacle in obtaining such empirical evidence is that many currently available nutrient profiling systems vary largely in their underlying approach, format, and content (Garsetti et al., 2007). Signpost labels typically claim to be based on the prevailing scientific knowledge about diet and health. Some are based on the nutrients to be encouraged, others on the nutrients to be discouraged, or a combination of both. No scientific agreement exists on how to determine the best nutritional profile of a given food (Drewnowski, 2007; Foltran et al., 2010). As a result, differences between the classifications of foods are common in that foods classified as "healthy" in one system can be "unhealthy" in another system. In addition, the ways systems categorize foods differ, as there are no universally accepted food categories from a nutritional point of view (Garsetti et al., 2007; Foltran et al., 2010). Together, this makes it complicated to collect evidence that signposting systems are able to improve consumers' diet quality.

In the absence of direct empirical evidence, researchers use modeling approaches to assess the potential impact of a labeling system on various outcome measures such as body mass index and health. But here also the outcomes of these exercises differ. Sacks and colleagues (2011a, 20011b) estimated the potential impact of traffic light labeling and concluded that a population-wide intervention as traffic light labeling is likely to offer excellent "value for money" as obesity prevention measure. Estimates of intake changes were based on an assumed 10% shift in consumption toward healthier options in four food categories (breakfast cereals, pastries, sausages, and ready-to-eat meals) in 10% of the adults. Given this assumption, a traffic light intervention would lead to a reduced mean weight of 1.3 kg corresponding with significant reduction in health burden and health care costs. Temme and colleagues (2011) quantified the possible impact of nutrition labels on the intake of fat, sugar, and sodium in a Dutch population of young adults. They showed that reduction in the consumption of negative nutrients, such as fat, sugar, and salt, could be possible if food manufacturers reformulate their products according to current Choices health label or even stricter criteria. A similar modeling approach was applied by Roodenburg and colleagues (2009, 2011) assessed the potential effect on nutrient intake in a variety of international populations after replacing normally consumed foods in diets with foods that are eligible to carry a Choices label. Results of this simulation analysis were that this lead to substantial improvements in nutrient and a moderate change in energy intakes. Vyth and colleagues (2011a, 2011b) used national food consumption and food composition data to estimate the nutrient intake of the Dutch adult population before and after replacing foods that did not comply with the Choices label criteria. Their findings suggest that the consumption of foods complying with these criteria could contribute moderately to cardiovascular risk reduction via influencing blood lipids. Foltran and colleagues (2010) are not that positive. They similarly performed a simulation exercise in the European population in which they tested the potential effectiveness on mortality and weight loss of the implementation of nutritional profile recommendations for the reduction of salt and fat intakes. They considered the effectiveness of food profiling in the prevention of disease to be limited.

In sum, evidence is limited and mixed, also due to the inherent difficulty of long-term experimental research in this area.

TRUST, TRANSPARENCY, AND GOVERNMENT ENFORCEMENT

For the majority of promised health benefits or provided nutrition guidance on a food label, the average consumer cannot directly verify or experience these benefits, often not even after consumption. The so-called credence aspect of information requires trust of consumers regarding the information and the providers of this information (Grunert, 2002). Trust in nutrition information depends first of all on a trustworthy source of information. Furthermore, for a label to be credible, it should be transparent who is responsible for it (Grunert and Wills, 2007). Some nutrition profile schemes currently available are created by manufacturers, others by the government or by the coalition of industry and non-industry stakeholders (Lytton, 2010). Information endorsed by well-known and trusted organizations increases the credibility of nutrition labels (Feunekes et al., 2008). Trust is also built through transparency in the underlying labeling criteria. Some nutrition signpost systems are very transparent about the criteria applied, while others are less. For example, NuVal and Guiding Stars are based on unpublished algorithms (Lytton, 2010). FOP labeling schemes may also be distrusted when consumers realize that evaluations of foods based on different profiling systems vary considerably (Trichterborn and Harzer, 2007), or when food manufactures have to pay a licensing fee to display the label on food that meets the criteria. Trust is typically increased if people feel that stakeholders responsible for communication or preventative actions have similar interests or values as those held by consumers (Van Kleef et al., 2009). Industry is typically seen as a less trustworthy source of information. This is because economic interests and motives are key reasons for distrust in the sense that consumers worry that actors who have economic interests for putting labels on food packages will be more concerned about profits than consumers' health interests.

Familiarity of information can also increase trust (Wansink, 2005). For example, relationship between calcium and bone strength is well known and therefore more likely to be trusted, even though the information might be irrelevant for the product.

For nutrition labels this implies that it may take years before consumers become aware of and make use of a particular nutrition label. This resembles the findings of Grunert and colleagues (2010b), who showed that the front-runner position of the United Kingdom in Europe with regard to promoting FOP labeling is the likely explanation why the UK consumers make more use of these labels. About 42% of registered US dieticians indicated that they instructed clients to look for FOP labels (Latortue and Weber, 2010), which would likely result in more familiarity over the years. On the other hand, people may also become accustomed to typical figures and nutritional values and learn to ignore them over time (Szanyi, 2010). Trust may also be lowered when people experience FOP labels as an intrusion in their personal freedom of choice. For example, consumers who are not interested in healthy eating tend to use FOP labels less or avoid them because they feel that these labels are an unwelcome attempt to control their behavior (Food Standards Agency (FSA), 2009). Eating is a major source of pleasure in life. A French consumer group association argued that for French consumers FOP labeling systems is an intrusion. For them, traffic light systems are incompatible with the French food culture, where the pleasure of eating is upfront and labeling may stigmatize eating of certain products (Holdsworth et al., 2010). Grunert and colleagues (2010b) found that consumers use signposting labels for already healthy products but ignore it on indulgent products. A warning sign, such as red traffic light label, may also be ineffective as it could backfire. This "boomerang" effect has been shown for cigarette and alcohol warnings, which make these products more desirable, particularly to young consumers (Kozup et al., 2001). To our knowledge, there is yet no empirical evidence for this in the food domain.

FOP labels are under the influence of various pressure groups such as public authorities, consumer associations, food companies, and retailers and this may impact consumer trust. The UK government has a preference for a system in which most guidance is given to consumers in terms of what is good and what is less good, such as a traffic light system (Food Standards Agency (FSA), 2009). These labels openly take a position on the nutritional content of a product (Magnusson, 2010). Dividing foods visually into good ones and bad ones seem to be the best option understood by consumers, but at the same time most debated by various stakeholders. The food industry has opposed this system and is typically in favor of summary GDA information or a "seal of approval" label, in which a product is never presented in an unfavorable frame (Bussell, 2005; BEUC, 2006; Lobstein and Davies, 2009; Magnusson, 2010; Andrews et al., 2011). In particular, the argument of the food industry against too strong government actions, such as imposing traffic light systems, is that individuals have a free will to make choices and hence unhealthy food choices are caused by the irresponsibility of individuals (Brownell et al., 2010). Furthermore, it has been argued that traffic light systems do not provide incentives to lower the amount of certain undesirable nutrients, such as fat and salt, as the values within an assigned color are quite broad (Williams and Colyer, 2009).

In a similar vein, label schemes initiated by the food industry have been accused of using category-based criteria that are not stringent enough, which happened to the Smart Choices label, which was introduced in the United States in early 2009 by a group of food companies, public health organizations, and scientists and nutrition educators. According to critics, the program's standards were too low, resulting in "junk foods" to be entitled to carry the label. The initiative was threatened by legal action and was put on hold in the same year (Schor et al., 2010). One of the biggest complaints is that "healthier foods are not necessarily healthy" as argued by Nestle and Ludwig (2010). They make a case for an outright ban of FOP labels as they mislead consumers due to their inevitably arbitrary standards, which are subject to manipulation. Food companies and retailers involved in these systems merely act out of self-interest and this lead to situations that mislead consumers. Voluntary industry-sponsored initiatives are also criticized as these are done only to head off legislation, and "position" the food industry so that it seems to be responsive to consumer concern about diet and nutrition (Magnusson, 2010).

Front-of-pack nutrition labeling is not yet compulsory in the European Union and the United States. The European Commission adopted a proposal to standardize and improve food labeling, but the exact required nutrition profiling system and label format is still under review (Holdsworth et al., 2010). In the United States, the Food and Drug Administration (FDA) intends to develop uniform nutrition criteria on which FOP labeling must be based, and began asking for public comments on ways to enhance the usefulness for consumers (Pomeranz, 2011). Some observers say the FDA is readying for what will be the most extensive food-labeling reforms since 1990 (Narayan, 2010). Good regulations may advantage consumers in that these may give labels more credibility and can reduce consumer skepticism (Caswell and Padberg, 1992). Adopting a single national or even international scheme has been advocated as a measure to prevent confusion among consumers, regulators, and manufacturers (Drewnowski, 2007; Sacks et al., 2011a, 20011b). The food industry is not in favor of mandatory schemes because these are very costly and they fear the risk of restricting innovation and competition. Allowing for experimentation with labeling within the private food sector could also advance knowledge on how to use food labeling as a public health strategy (Lytton, 2010). Important to note is that the dynamic nature of nutrition science, coupled with changes in consumer behavior, may require adaptations from time to time. For example, recently nutrient density has been promoted as a relevant guiding factor in nutrient profiling methodologies (Miller et al., 2009; Nicklas, 2009).

CONCLUDING REMARKS

The majority of stakeholders involved, such as government, health organizations, food industry, and consumer associations

increasingly emphasize the need for FOP nutrient logos. Efforts to promote healthy food choices have risen higher on the agenda and a food package is the first opportunity to teach people about healthy food choices. We have critically reviewed the literature in the consumer domain of FOP labeling to illustrate the strengths and weaknesses of this form of nutrition education from a consumer perspective. At the heart of the current nutrition signposting debate is the concern whether signposting schemes are simply self-promotion strategies for the food industry or whether they actually improve consumer diets and health in the general population. Proponents suggest that FOP labeling is effective and feasible in helping consumers make healthier choices (Feunekes et al., 2008; Lobstein and Davies, 2009) and that they have a positive stimulating effect on product innovation in that it encourages food manufacturers to alter the nutritional composition of their foods in beneficial ways (Rayner et al., 2001). Opponents warn that excessive amount of nutrition information creates confusion among consumers and could be deceptive (Nestle and Ludwig, 2010). In order to promote a healthy diet, the World Health Organization (2008) recommends the provision of accurate and balanced information for consumers to enable them make well-informed, healthy choices. Although conflicting interests may hamper further development, FOP labels could play a necessary role in achieving this recommendation.

Overall, FOP label research has progressed since the appearance of these labels on packages. Nevertheless, the majority of consumer research on use and understanding of nutrition information on food labels has been conducted in the United Kingdom, and makes difficult to generalize it to other parts the world (Cowburn and Stockley, 2005; Grunert and Wills, 2007). Different FOP nutrition labels signal the healthiness of a food product in different ways. International research indicates limited and mixed results with regard to which system is best in terms of awareness, understanding, and use (Pomeranz, 2011). Deciding what and how much to eat is, for many consumers, a low-involvement behavior based on habits. When shopping for groceries, people have limited motivation and opportunity to extensively look for information due to time pressure and distractions. It also depends on the goals that a consumer has while shopping (e.g., a particular diet goal), and this shows that one goal does not fit all consumers. For example, for consumers with hypertension, a general health mark is less informative than a GDA label with more specific information on sodium. Grunert and colleagues (2010a, 2010b) argue that the debate on the best form of FOP labeling has concentrated too much on the issue of understanding, and too little on the question of motivation for healthy eating. Moreover, the potential negative effects of labels on consumer choices have received little attention and require more consideration in future FOP labeling development and research. The more the nutrition information is summarized, for example in a single score, the more (valuable) the information is lost (Lobstein and Davies, 2009) and misinterpretations are likely to occur. In particular, positive framed nutrition labels may act as a kind of "good for you" messages that encourage overconsumption of those products. Health halo effects seem to be stronger for simple "seal of approval" systems (Andrews et al., 2011).

A major controversy in the nutrition signposting debate is the question whether these labels will actually lead to healthier food choices and less nutrition-related diseases. Although FOP labeling is frequently advocated for changing unhealthy food habits, little empirical and consistent evidence exists to support nutrition labels designed to improve eating habits. Eventually, evidence will be required about the ability of nutrition signposting systems to improve consumer diets and health. Research on actual impact on diet and health is complex and time-consuming and simulation analyses, which are done as an alternative, are sometimes based on ambitious assumptions (e.g., consumers switch to a diet with merely or exclusively foods that are entitled to carry a label) and paint an inconsistent picture of the potential impact. Although our understanding of consumer responses to FOP labels is growing, numerous consumer questions remain unanswered. For example, what are the optimal design characteristics of FOP labels, and what are spontaneous consumer inferences that may impact perceptions and food intake (Andrews et al., 2011)? Traditional consumer research approaches, based on self-reporting, are valuable but limited as consumers tend to give socially desirable answers. A more realistic understanding could be obtained by field experiments with actual food choices or search behaviors as key dependent variables to study how real-life shopping behavior interacts with various environmental cues and personality characteristics.

The fundamental assumption under signposting labeling is that consumers, given the right motivation and information, can successfully change their diet in a more healthful direction over a long term. A general belief is that people themselves should take more responsibility for their unhealthy food choices. An alternative view is that the environment has more control than individuals themselves because eating to a large extent is an automatic behavior (Cohen and Farley, 2008). The motivation of people to eat healthy may diminish the moment they are confronted with indulgent foods. The modern food environment has been called a "toxic" food environment because of the abundance of cheap, energy rich nutrient poor foods (Brownell, 2005). This "toxic" environment makes it hard for consumers to be responsible and make informed healthy choices. In this environment, FOP information competes with other factors. Subtle environmental factors in out-of-home food environments, such as the supermarket assortment structure and the size and manner in which food is accessible and presented, or the available default options at menus in restaurants, can shape consumer preferences and affect what they purchase. In particular, altering the social environment of consumers that support food behavior changes is increasingly seen as one of the most promising and effective policy directions (Story et al., 2008; Thaler and Sunstein, 2008). Consequently, nutrition signposting logos should become part of a broader basket of policies to encourage people to change their eating habits. When the environment does not support healthier choices, it becomes problematic to expect

consumers to act in accordance with long-term health goals. Other useful approaches that deserve more attention include reducing portion sizes, limiting the availability of snack foods, and reducing food advertising (Cohen and Farley, 2008). In addition, for an effective public policy tool to be developed, it is important to understand the factors that influence consumer trust in nutrition logo schemes. Consumer trust could be negatively influenced by the similar occurrence of a number of logo systems in the market place. It might take years for consumers to fully embrace and understand a logo. This requires commitment from both consumers and other actors involved. It may be a similar process as with brand loyalty in which consumers attach themselves to a brand over the years.

While it is widely acknowledged that the problem of nutrition-related diseases does not have a single solution, nutrition labels may play a role in promoting healthy food choices. This paper, however, has shown the necessity to develop more real-life understanding in the consumer psychological phenomena surrounding the key issues and controversies of today's nutrition labels debate. Eventually, when the target of nutrition signposting labels are consumers, it seems logical to emphasize the pivotal importance of understanding consumers' information processing and decision-making better. Examining the scientific and value base of established or new nutrition signposting labels will be vital to make realistic estimations and expectations about the effectiveness of nutrition labels with respect to improving consumers' dietary choices and health – prime objectives of nutrition labels in current scientific and policy discourse.

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