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Position paper

Front-of-pack labels: "Directive" versus "informative" approaches

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ABSTRACT

Front-of-pack labels (FOPLs) aim at communicating to consumers the health value of food items in support of public health policies. Two main types can be discerned: directive and semidirective FOPLs using color schemes (e.g., Nutri-Score) and informative FOPLs (e.g., Nutrinform Battery). Directive approaches tend to show a "wear-out effect" and, additionally, they tend to have various underlying conceptual problems. Usually, their nutritional scores are calculated using changing, arbitrary algorithms and involve a reductionist set of parameters of debatable validity. Thus, they overstate the effects of selected nutritional factors, such as saturated fat and energy, while overlooking the food matrix and the more holistic aspects of nourishment. Moreover, they do not reflect the portion that is consumed, ignore the preparation steps at home, and fail to serve as a useful basis for composing a healthy diet. Also, so long as the nutritional formulations match the algorithmic standards, they tend to allow ultra-processed products. Thus, this might confuse and mislead consumers. Overconfidence in green-colored labels could even result in unbalanced dietary choices, whereas avoidance of red products may eliminate certain foods from the diet that are rich in essential nutrients (e.g., cheese), leading to opposite results than aimed for. The latter is particularly relevant to vulnerable populations, such as the young, pregnant women, and older adults, or for individuals with specific needs. Taken together, directive FOPLs such as Nutri-Score contradict the declared intent of the European Commission to empower consumers to undertake healthy and balanced diets based on easily accessible and robust information. Although informative systems usually also keep the focus on a few selected nutritional parameters, they have are less paternalizing and obviate the need to classify foods as healthy or unhealthy. They also focus attention on the individual portions that are consumed (even if the definition of portion size remains contentious). Given the importance of dietary patterns, rather than individual foods or nutrients, directive-FOPLs of the Nutri-Score type represent a regretful case of nutritionism. Finally, attempts to associate the adoption of a FOPL with an improvement in the health status are few and mainly applied in virtual settings; none of which are longitudinal, nor have they been able to identify a causal link.

Introduction

The prevalence of obesity and non-communicable diseases (NCDs), such as cardiovascular diseases, cancer, chronic respiratory diseases, and type 2 diabetes, is increasing with a significant effect on morbidity, mortality, and quality of life [1,2]. Eating habits, as an important aspect of overall lifestyle, play a major role in this development [3]. Providing information to consumers on what constitutes healthy eating has the potential to positively effect dietary habits [4,5], an opinion that has been endorsed by both the European Commission (art.35 of Regulation No 1169/2011) and the United Nations (art. 34 of the Political Declaration of the Summit of the Heads of State and Government of 09/27/2016, adopted by the UN General Assembly on 10 October 2018).

Previous strategies, which were based on "bac-of-pack-labels" (BOPLs), unfortunately failed in that mission, with public health policymakers increasingly finding themselves in dire straits because of the worsening situation of community health, especially regarding the continuing increase in NCDs. Therefore, in 2011, the European Commission decided to adopt a simpler procedure, but this time based on front-of-back labels (FOPLs). The purpose of the latter strategy was to inform consumers more clearly, while also having an "educational" function.

FOPLs can be distinguished according to the complexity of the information that is provided (e.g., displaying nutrient-specific information or declaring a global judgment on the whole product), as well as their "directionality" (e.g., the kind of steering or evaluative message regarding healthiness) [6]. On these bases, they can be categorized as follows (Table 1):

On a non-remunerated basis, FL is a board member of various academic non-profit organizations including the Belgian Association for Meat Science and Technology (president), the Belgian Society for Food Microbiology (president), and the Belgian Nutrition Society, and has a seat in the scientific committee of the Institute Danone Belgium, the World Farmers' Organization, the Advisory Commission for the "Protection of Geographic Denominations and Guaranteed Traditional Specialties for Agricultural Products and Foods" of the Ministry of the Brussels Capital Region, and a Scientific Advisory Committee of the Food and Agriculture Organization of the United Nations. LMD is member of different boards of scientific societies dealing with eating behaviors and food science (Italian Society for the Study of Eating Disorders, Italian Society of Obesity; and the European Society of Clinical Nutrition and Metabolism). The authors have no conflict of interests of interest to declare.

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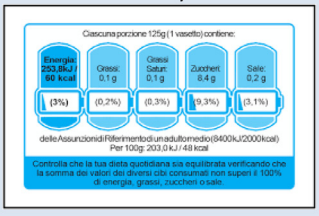
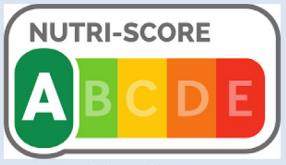
Table 1
Different examples of front-of-pack labels

	Informative Non-Directive	Semi-directive	Directive
Definition	Provides information such as the name of nutrients included, their amount in grams, and their percentage in relation to total daily requirements	Provides not only nutritional information, but also an evaluative element such as a color, a word, or a sign that gives additional information emphasizing the healthiness levels of single nutrients	Includes little information, often aggregated in a single symbol, and combining several criteria. Some of them (Swedish Keyhole and Dutch Healthy Choices) are applied on products in combination with nutritional information labels front-of-pack or back-of-pack. Other (e.g. Nutri-Score) only give an indication about the healthiness of the product, expressing judgements, opinions and/or recommendations, without providing specific information on single nutrients.
Examples	Nutriform Battery 	1) English traffic light or *Multiple Traffic Light* - MTL  2) Warning Signs which may feature the octagon "stop" or the words "rich in" (Chile)  3) Israeli system of red pictures for excess salt, fat or sugar and positive green symbols for healthy products 	1) Swedish Keyhole  2) Nutri-Score  3) Dutch Healthy Choices 

- Informative "non-directive" labels that provide information such as the name of nutrients included, their amount in grams, and their percentage in relation to total daily needs and allowances (e.g., Nutrinform Battery [NIB]);
- "Semidirective" labels that not only provide nutritional information but are also completed by an evaluative element such as a color, a word, or a sign that gives additional information on the healthiness level of the single nutrients, thereby emphasizing them (e.g., the English traffic light or multiple traffic light [MTL] and warning signs, which may feature the octagon "stop" or the words "rich in" or the Israeli system of red pictures for excess salt, fat, or sugar and positive green symbols for healthy products) [7].
- "Directive" labels that include little information, often aggregated in a single symbol (e.g., Swedish Keyhole, Nutri-Score [NS]) and combining several criteria. Some of the "directive" labels (e.g., Swedish Keyhole and Dutch healthy choices) are part of a communication strategy aimed at increasing nutrition literacy in the population and are applied on products in combination with nutritional FOPLs or BOPLs. Other variants (e.g., NS) only give an indication about the healthiness of the product,

expressing judgments, opinions, and/or recommendations, without providing specific information on single nutrients.

The aim of this paper was to verify the usefulness of "directive" FOPL, and of NS, and make a briefly comparison with informative tools (such as the NIB) as a means to promote a better nutritional and health status within the general population.

Directive FOPLs

Directive systems (e.g., NS) normally impose a "traffic light" system or color code on consumers, offering suggestions on what to purchase but without providing information on the nutritional characteristics of a food, or on its recommended portion size and frequency of consumption. The most widespread FOPL in Europe is represented by NS, which was adopted in France in 2017 and in other European countries since then (Belgium in 2018, Switzerland in 2019, Germany in 2020, and Luxembourg in 2021). It is based on a color scale ranging from green to red, accompanied by letters from A to E.

Choice of parameters in the algorithm

A major concern is that directive systems (and NS in particular) score the nutritional value of foods based on a narrow set of selected nutritional criteria (e.g., energy, saturated fat, salt content, fiber, proteins, and fruit/vegetables), without taking into account the extremely important relevance of other important nutritional factors (e.g., the contents of important micronutrients that are already limiting in many populations, such as iron, zinc, and vitamin B_{12}, or other nutrients of importance, such as choline and long-chain ω-3 fatty acids). This results in both a lack of robustness of the nutritional message and a substantial degree of arbitrariness of the algorithms underpinning it.

Moreover, the true causal effect of the selected criteria on the health value of a food is in many cases highly uncertain and contextual. Energy content (in kcal), for instance, is not a very helpful basis as it overlooks the true drivers of overeating, which are the satiety-inducing effects of certain foods (or their craving effects, for that matter) and endocrine responses to the type and status of specific food components. As an example, it is known that some ultra-processed foods give rise to overeating [8], but the level of processing has not been taken into account in systems like NS (in contrast to other systems such as NOVA) [9]. Differences in the processing of bakery products, for instance, affect the nutritional attributes of baked goods, which remains unaddressed by NS [10].

The role of the food and diet matrix

The role of the food matrix is essential when addressing the nutritional effects of a given food product, which tends to be more than the sum of its nutrients, among other reasons, because of nutrient interactions and the presence of a broad (and usually poorly charted) spectrum of bioactive compounds [11]. The dairy matrix constitutes an often-cited example [12]. Therefore, isolating a few nutrients will be poorly informative of the actual nutritional effect, especially when their health effects are uncertain. The situation becomes even more intricate when considering the diet matrix and the health effects that relate to dietary patterns, consisting of various food combinations over time.

For instance, the evidence in support of the use of the single and simplified category of "saturated fat" as a health discriminator for food-based recommendations is debatable, given that many systematic reviews and meta-analyses fail to substantiate harmful effects (see, e.g., Gershuni [13]). Moreover, the category contains different types of fatty acids with varying biological effects, which also depend on the food matrix. Therefore, some foods that are rich in saturated fat are *not* associated with increased disease (e.g., whole-fat dairy) [14]. Similar concerns relate to the setting of specific sodium targets to improve health in normotensive populations, realizing that the effects of sodium also depend on the dietary pattern, including modulation by potassium [15].

As an example of a "positive" nutritional factor underpinning the algorithms, fiber content is indeed associated with improved health in various epidemiologic studies, but this may be mainly because of its proxy role in the wholesomeness of foods (rather than fiber per se) [16]. The findings for fiber also are contingent on the dietary and metabolic context [17]. Therefore, the health bonus in NS may be overstated for *added* fibers (of which the effects are fiber- and context-dependent). The latter can be added to unhealthy products to create a health halo and for mere nutriwashing purposes (translated into a positive nutritional score), without necessarily making such foods intrinsically more healthful: a vegetable pizza with an NS score of B can be further improved to A by decreasing salt by 0.15 g/100 g of products and with the addition of 0.15 g fiber, which has a very limited nutritional relevance [18].

By ignoring all the aforementioned complexities, the simplified scores of "directive" FOPL like NS suffer from nutritional reductionism (*nutritionism*) [19]. They excessively focus on a narrow set of nutrients while ignoring both the wider scientific discussion and the holistic and versatile aspects of human diets [20]. Reliance on the so-called transitive property of the individual nutritional factors just mentioned is problematic to begin with ("if a certain nutrient is statistically or epidemiologically linked to a certain disease, changing the concentration of that nutrient will have a positive effect on the prevention of the disease" [21]). This principle has been disproved on many occasions (e.g., even if increased intake of folic acid, B_6, and B_{12} vitamins reduces homocysteine levels, it fails to affect cardiovascular risk) [22,23]. Upon scrutiny, many food items or groups (cheese, butter, total dairy, red meat) and single nutrients (saturated fat, sodium), in epidemiologic studies, fail to lead to meaningful harmful epidemiologic associations with clinical health outcomes [24–32].

Internationalization of an algorithm based on a national consumption pattern and food compositions

To further illustrate the arbitrariness of the setup and the inherent difficulties in establishing unambiguous nutrient profiles at the European Union (EU) level, the following needs to be stressed:

- It is difficult to set the application of nutrient intake recommendations for the general diet to individual foods;
- There is a lack of uniform data for the composition and consumption of foods across the EU; and
- There are differences in nutrient intake recommendations and dietary guidelines within EU countries themselves [33].

Because the NS system provides an overall evaluation of an individual food, it does not outline the information on the individual factors included in the algorithms. The latter, however, could be the result of many combinations of levels of different factors (high levels of one or more factors that are considered negative—energy, total sugar, saturated fatty acids (SFAs), and sodium content—and/or low levels of one or more factors that are considered positive—fruit, vegetables and nuts, fiber, protein and seed, walnut and olive oil content). Therefore, whole-meal short-bread biscuits

made with different recipes almost invariably obtain the identical scores regardless of the presence of characterizing ingredients (whole-meal flour varies from 20 to 70% of the total ingredients) and the lower or higher sugar content (from <2 to >20 g/100 g) [34].

These uncertainties make the definition of FOPL (particularly the directive type) very complex, which may, not surprisingly, lead to the need for annual updates of the NS algorithm developed in 2021 and 2022 by the Scientific Committee of NS.

In that context, nutrient-centric FOPLs often are endorsed by multinational corporations that produce ultra-processed foods. Even if the term *ultra-processed* is generating a great deal of confusion in certain consumer groups and the food production sector because of its controversial interpretation [35]. Therefore food industries, given their expertise in extensive processing, are reformulating ("tweak") their products by somewhat reducing the levels of some of the harmful nutrients with synthetic sweeteners (to decrease sugar), salt replacers, combinations of texturizers and flavoring agents to compensate for fat reduction, or by adding ingredients with a healthy halo (e.g., fiber).

The following is an example of how this may translate into confusion and arbitrariness. The original algorithm of NS attributed a single negative point both to 4.5 g of sugar and 1 g of SFAs. Subsequent adjustments led to the attribution of one point for 5 g of sugar and 1.5 g of SFAs, with highly questionable influences on health outcomes. A recent update report further modified the algorithms to accommodate criticism related to some highly questionable outcomes of the original NS setup (e.g., by ameliorating the outcome for fatty fish, which is currently receiving a discouraging NS).

The example of unprocessed red meat further confirms the arbitrariness of the scoring process. To accommodate the caution related to excessive consumption levels expressed by several health organizations (e.g., WHO/IARC), NS downgraded the score of unprocessed red meat using "a reduction in the number of maximal protein points [of red meat] to 2 points." Currently, a positive score for red meat is "due to the favorable points allocated in the protein element of the algorithm, while lean plain meat will have relatively little unfavorable points on energy density, saturated fat or salt." To do so, the algorithmic modification was built on a hypothesis connecting red meat consumption to health risks, arguing that this would be caused by heme iron. As for saturated fat, such assumptions are based on a scientific debate still in progress [36,37]. A comprehensive analysis using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) approach has shown that the evidence for a causal role of red meat in the development of NCDs is of (very) low certainty and not fit for strong recommendations [38]. The heme iron rationale advanced by the NS committee contributes to this uncertainty, as potential harmful effects of heme iron are mitigated in a balanced dietary context, following risk assessment [39]. This once more stresses the importance of the diet matrix. Moreover, even if discouragement of red meat may be pertinent for some (e.g., those at risk for iron overload), blanket recommendations may exacerbate the health problems of others because of a reduced intake of valuable nutrients that are highly bioavailable in red meat, among which heme iron, especially in at-risk populations. The latter include children, older adults at risk for sarcopenia, and premenopausal women (many of which already suffer from iron deficiency, even in the West, due to changing dietary patterns [40,41]).

An additional problem related to the use of a single algorithmic setup for very different product groups is that it does not sufficiently separate foods that are high in some nutrients with a negative or positive score effect (i.e., saturated fat or fiber). For example, the lack of discriminating criteria within a specific product group leads to an unbalanced distribution of cheeses within the NS spectrum, with >80% of the products receiving a D score [42]. As argued previously regarding meat, cheeses also serve as an essential source of important and highly bioavailable nutrients (e.g., calcium and proteins). Also, white and whole-meal breads are scoring very similarly, although the latter would have to be promoted over the former, as to stimulate fiber and micronutrient intake [10]. Finally, several studies show that the NS is not aligned with the national dietary guidelines (e.g., the Netherlands [42,43]).

Consumption aspects related to portion size and preparation

In addition to the problems of robustness and arbitrariness, the resulting information is disconnected from the reality of consumer behavior and may therefore be misleading. Often, "directive" systems are based on a standard quantity of food (per 100 g or 100 mL), which is unnecessary and, arguably, rarely corresponds to the portions consumed. Some foods that receive a favorable score can be consumed in large quantities that may lead to concern (e.g., industrial vegetable pizza), whereas other foods may obtain unfavorable scores although they are generally consumed in small portions and have well-documented health benefits (e.g., olive oil) [44]. Also, some foods with green scores at the retail level will still undergo cooking procedures at the consumer level, potentially involving unhealthy preparation steps (e.g., frying).

Consumer education

For consumers, directive FOPLs like NS are not a useful basis for choosing the overall composition of their diets, nor do they allow consumers to appropriately combine foods and adhere to a specific food pattern [34]. Therefore, they lack the "educational" purpose initially envisaged by the European Commission. Worse still, "directive" FOPLs, like NS, risk becoming misleading by distracting attention from the Nutrition Facts tables reported on the package [45]. Typically, consumers associate a green color with the food being healthy or natural, regardless of the nutritional information provided on the BOPL. In fact, when the packaging for the same product was experimentally prepared with two different labels (green and red), consumers chose the product labeled in green and did not read the information featured on the nutritional label [46]. Because the perceived and actual understanding of nutritional information can differ considerably [45], it should not necessarily be expected that "directive" FOPLs may improve nutritional literacy. Consumers may also value a food with a green label as healthier than one labeled in red, regardless of the food category they belong to, even if it is sometimes claimed that the system is not intended as a tool for comparing the nutritional value of products from different categories. A recent study used NS for the standardized comparison of very different foods, leading to various debatable and questionable outcomes [47]. For example, foods such as frozen chips, rolls, and wraps were presented as nutritionally superior to seafood, milk, cheese, and eggs. As an undesired outcome, an inexperienced consumer may mistakenly try to follow a diet composed only of products in groups A (dark green) and B (light green), which is not necessarily nutritionally adequate and could even lead to unbalanced diets. Therefore, the effectiveness of directive FOPLs to lead to the adoption of healthy dietary patterns and a reduced risk for developing NCDs has yet to be demonstrated [48,49].

Effects on purchase behavior

Often, the determinants influencing food choices are assessed individually rather than in a holistic, synergistic, and multidimensional context. In contrast, a representative purchasing scenario would need to be characterized by multiple stimuli to which the consumer is subjected ("bombarded") at the point of purchase. Information, condensed into a color or number, might facilitate better food choices and improve the nutritional quality of the shopping basket [50,51]. In contrast, it might have the opposite effect and misguide consumers, resulting in greater consumption of unhealthy food [52,53]. More recent studies seem to acknowledge the capacity of FOPLs to improve the overall quality of the shopping basket, particularly when they are part of a communication strategy aimed at increasing nutrition literacy in the population (Swedish Keyhole and Dutch Healthy Choices) [54]. However, the actual effect of FOPLs on consumer behavior and their direct positive correlation with the individual health status has yet to be proven [21].

Validity over time of FOPL messages

Directive warnings frequently show a wear-out (fatigue) effect, decreasing the effectiveness of the warning message over time. The experience with cigarette warning labels has demonstrated that, after a first success, implementation of pictorial labels in addition to the text was required for more effective outcomes. Even so, after a prompt increase in effectiveness, the wear-out effect was observed again, leading some governments to change the displayed images to maintain results over time frequently [55,56]. More informative approaches, if they can achieve educational effectiveness by contributing to a broader nutritional awareness, may reduce this effect by empowering consumers. Ideally, consumers should be enabled to situate individual foods and nutrients within a context of overall nutritional needs and dietary patterns rather than being misled by simplistic color schemes or other examples of "health halos" based on simplified claims, such as being “low in calories” or “low in fat” [57]. The experience with "light" food products, which are associated with alleged healthier qualities, led to greater consumption but failed to result in reduced obesity, suggests caution in classifying single foods as “good” or “bad” based on simplistic assumptions [58–60]. Moreover, the use of artificial sweeteners may come with negative health trade-offs that are not captured in the score, thereby undermining the validity of the current favorable NS of, for instance, light sodas [60,61].

Informative FOPLs

An example of an informative FOPL is provided by the Italian NIB, which adopts the cell phone battery symbol to summarize the daily consumption of five elements: calories, fat, saturated fat, sugar, and salt. These batteries show the amount of each element contained in a portion of the food considered, as well as its contribution to the daily requirement according to the Dietary Reference Values established by the European Food Safety Authority. How the batteries are filled in is compared with the recommended amount for each nutritional element. In this way, the system informs the consumer to situate the intake of these nutrients per food in their daily meal formulations so that they can manage their daily constitution in a balanced manner.

As for directive FOPLs, restricting the information to five parameters only provides a narrow view of food’s nutritional value and the importance of the food matrix. Also, the same objections to the validity of these criteria, given the totality of the scientific evidence, can be raised similar to those discussed for NS. However, “informative” approaches are less paternalizing and judgmental toward consumers and do not have the intention to label individual foods as "healthy" or "unhealthy." They also focus their attention on the average portion size as defined by national organizations, helping consumers understand how these will fit into their daily dietary consumption pattern in combatting obesity [62]. Including portions in the setup is critical, especially in the current foodscape with its emphasis on oversizing ultra-processed foods, which is likely responsible for overeating. Informative FOPLs may elevate consumer awareness of proper food servings and encourage the food industry to reformulate potentially health-critical products and reduce portion sizes [44]. It is difficult to identify true portion sizes, especially in “family packs” and other formulations with suggested portion sizes, as these depend on individual preferences and eating cultures [63,64]. The definition of *food portions* is not always specified in different national nutritional guidelines and may vary from one manufacturer to another. It also opens pathways for producers of unhealthy foods to manipulate the declared portion size and, therefore, the FOPL message.

Starting from an informative principle, systems such as the NIB attempt to respond to the European Commission and United Nations request for better empowerment of consumers to induce them to undertake healthy and balanced diets. By referring to the overall characteristics of the diet, these systems overcome the limits represented by the difficulties in defining the nutritional profile of foods. There are several models available (e.g., Ofcom/FSA NP model, WHO-Euro model, Health Canada Surveillance Tool system), but to our knowledge, there is no consensus on which of these has should be considered as a reference [65,66]. In contrast to directive FOPLs, such as NS, informative FOPLs, such as the NIB, offer a better option to achieve proper combinations of various foods (e.g., the choice of food for which the system assigns a high content of fats and sugar can be "balanced" by eating other foods with lower content of these nutrients). Likewise, when relevant, they also facilitate the selection of foods according to specific individual needs (energy content, sodium, or saturated fat content) [5]. The presence of the battery symbol may enable respondents to see if their consumption aligns with the recommended daily intake, so that meals can be balanced accordingly [67]. Improved understanding and preference for informative (NIB) over directive (NS) FOPLs was confirmed in different studies performed in various European countries [68–71].

The arguments mentioned earlier suggest that a strategy of informative FOPLs is more suitable for optimizing dietary patterns instead of focusing on individual foods and nutrients, an approach supported by scientific evidence [16,72,73]. Eating patterns consist of a combination of a variety of different foods. For example, foods like olive oil, cheeses, preserved meats, baked goods, and even sweets may seem harmful on an individual and simplistic assessment but are nevertheless an integral part of Mediterranean diets, widely acknowledged as a healthy eating pattern. Based on NS, salad dressings may have a better score than olive oil because of differences in energy density and saturated fat, but this is completely overlooking the healthy benefits that olive oil offers within a Mediterranean diet culture (supported by the rationale that it also is rich in monounsaturated fatty acids and antioxidants) [16]. The often-subtle interactions between various foods and between different nutrients, as well as the complexities of food matrices and how these are affected by food processing (for the better or worse), make a model effective in preventing NCDs. An approach based on the dichotomic classification of foods into "healthy" or "unhealthy" products, may present several pitfalls related to the oversimplification of this approach [34]. The EFSA

has challenged the validity of focusing on single nutrients (as it happens in directive FOPLs) [74]: "even though the effects of some individual nutrients and non-nutrient components of food on chronic disease risk are well established, these are usually found in foods and diets as complex mixtures, where synergistic or antagonistic effects may come into play."

As a drawback, the provision of more detailed information, as with the NIB system, could be challenging for communication because of the numerous numerical references present. This problem conflicts with the need for simple and immediate information by requiring a graphic and advertising design that may not always be effective. Also, the contextualization of the information offered requests basic nutritional knowledge. Be that as it may, it may be preferable to the simplistic approach of a single color or letter.

FOPLs and health status

Directive FOPLs mainly focus on the content of nutrients with "unfavorable" effects. In the NS setup, such nutrients confer ≤40 negative points compared with nutrients with "favorable" effects, which bear a maximum of 15 positive points [34]. This is in contrast with observations that dietary policies focusing on the promotion of the intake of under-consumed beneficial components likely will likely have a more significant effect than policies targeting "negative" nutrients. Among a list of 15 nutritional factors, of which the influence on health is allegedly highest, 11 referred to foods and nutrients that are consumed in insufficient quantities (e.g., whole grains, nuts, seeds, and seafood). Although their true causal role in the development of disease is still controversial, only sodium, red meat, processed meat, and sugar-sweetened beverages were consumed in excessive amounts [75,76].

Currently, the number of studies that associate the adoption of an FOPL with an improvement in health status are very few and mainly concern NS. None of them are longitudinal or have been able to identify a causal link between the adoption of the FOPL and the change in health status [49]. At best, the association is with the consumption of a food (an association with the variation of a risk biomarker was rarely found, and associations outlining effects on morbidity or mortality are missing). Many of the studies have only virtually applied the NS to preexisting cases, thereby if the adoption of the NS could—if applied to that specific case series—influence the adoption of different dietary patterns (which were spontaneously adopted by the enrolled participants) and their eventual health effects. The use of data extracted from existing studies, to which the possible effect of NS was subsequently applied with mathematical models, is a questionable experimental approach from a methodological point of view, which by definition cannot demonstrate the presence of causal relationships between the considered parameters. Moreover, a real-life setting may provide significantly different results due to important interfering and confounding factors [77,78]. Prospective controlled studies are missing [21]: Consumers were not exposed to the labels and did not choose the products accordingly, nor were their choices of labeled products observed over the long term, assessing the potential effect of FOPLs on health against no FOPL exposure. These studies examined FOPLs in isolated conditions, unaffected by external factors. Thus, they overlooked confounding factors such as compensatory consumption, increased physical activity, biases, overconsumption of foods perceived as more nutritious or healthy and, whether consumers use FOPLs as a mean of information before purchase [79]. The few studies that have been carried out in real-world supermarkets (most of them using NS) gave conflicting results (i.e., some studies found no significant effects on consumer behavior, whereas others found positive results in terms of a significant reduction in the purchase of products considered unhealthy) [21]. This indicated that FOPLs or shelf labels might, at best, achieve a small degree of success (<2%) in persuading shoppers to buy healthier foods [80,81]. Smed et al. [81,82] demonstrated that the placement of the Dutch Choices logo on products fulfilling the criteria for the logo, led some product groups to the switch from non-logo products to logo products. In other product groups, no change was observed. These studies were done by reporting all the products purchased in a household as well by analyzing data from the retail selling of products. A meta-analysis, including 114 articles on the effects of FOPLs on outcomes (i.e., ability of consumers to identify healthier options, product perceptions, purchase behavior, and consumption), has shown that, although FOPLs help consumers identify healthier products, their ability to nudge consumers toward healthier choices is more limited [48].

A labeling system with a positive character incorporating more informative nutrition signals may contribute to educational empowerment and avoid messaging that connotes judgment about what the consumer is eating (e.g., red lights) [83]. Focusing on positive "to-do" rather than on "not-to-do" behaviors can arguably increase the number of people adopting healthier eating habits [84]. Positive, gain-framed messages offer an actionable message that seems effective with the general audience, who are likely to have limited knowledge of the message topic, leaving a positive feeling and a motivated attitude [85,86].

Conclusions

To our knowledge, no robust evidence exists showing that adopting a directive FOPL system like NS will improve consumers' nutritional skills and awareness, thereby improving their purchasing choices in a real-life context. We should not assume that this will consequently improve the effective quality of their diets and that this would favorably modify their health status and reduce the incidence of NCD or mortality from any cause. Moreover, the structure and logic of a directive FOPL, like NS, does not provide much valuable or meaningful educational information [87]. An information campaign that emphasizes single nutrients or individual foods (which is the logical basis of directive FOPLs, such as NS) does not consider the synergistic interactions occurring between different food items and food components. It ignores the relevance of essential micronutrients (vitamins, minerals, and other bioactive compounds) and neglects the potential influences related to the frequency of consumption, the effect of (ultra)processing and the food matrix, and the further preparation and cooking by consumers. Many of the assumptions, such as those that relate to the health effects of saturated fat, are much less evidence-driven than often assumed. A "negative-based" communication approach, relying on bans or simplistic summaries and limiting information to single nutrients, does not capture the complexity of dietary patterns as part of a thorough lifestyle modification [18,21,88]. In contrast, and despite limitations, informative FOPLs have the advantage of situating the label information in a broader dietary context of daily intake and recommendation, thereby opening a more comprehensive nutritional perspective on overall equilibrium. Given that food is more than the sum of nutrients or mere "fuel for the body" (which, albeit, should be of the highest octane), and acknowledging that eating is deeply rooted in culture and has important social meaning and functions, it is our opinion that more constructive approaches are needed. Preferably, these should *positively* emphasize the importance of dietary patterns that have a proven record of healthiness and are typified by a long-standing contribution to the benefits of commensality, culinary legacy, and food traditions.

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