Front of Package Labeling Literature Review

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BACKGROUND AND CONTENTS

FDA is prioritizing its nutrition initiatives to ensure people in the United States have greater access to healthier foods and nutrition information we can all use to identify healthier choices more easily. Increasing the availability of healthier foods could improve eating patterns and, as a result, improve everyone’s health and wellness.

Claims and symbols can act as quick signals on the front of food packages to help consumers better understand nutrition information and select foods that are part of healthy eating patterns. Other aspects of food labels can provide consumers with further valuable information to help them to identify healthier foods.

To help consumers easily identify packaged foods that would meet an updated definition for the “healthy” claim, FDA is conducting consumer research to develop a “healthy” symbol that could appear on food packages.

FDA is also exploring the development of a nutrition labeling scheme referred to as front of package (FOP) labels displaying a summary of the product’s healthfulness or nutrient content. To support these efforts, FDA conducted and updated reviews of the literature to summarize what is currently known and understood about FOP labeling.

Pages 4 to 10 of this report are the body of the review – the body encompasses 1) a summary of key systematic reviews on FOP symbols, 2) an updated review of the FOP scientific literature, and 3) summaries from guides on government implementation of FOP labels. The Appendices contain: A) a table of FOP labeling schemes and symbols available online and in the scientific literature in 2018; B) the methods report including the study protocol; C) a summary of each article in the updated review; D) citations for articles in the updated review.

LITERATURE REVIEW

General Findings

While the FOP scientific literature is nuanced, the following themes emerged:

• A FOP rating system or symbol can help consumers identify and select healthy foods.
• Consumers generally prefer simple labels (such as the ones using a summary system).
• While more recent studies have examined which type of labels (summary system or nutrient specific) work best, additional research is needed to understand whether consumers’ use of these labels result in healthier diets and better health outcomes.
• Some manufacturers have reformulated products following the implementation of FOP nutrition symbols; some evidence suggests increased sales of products bearing a FOP symbol.
• Institutional endorsement of logos may be related to greater confidence in the label.

Introduction

Consumers can use the Nutrition Facts label (NFL) to learn about the product’s nutrients and how a serving of that product fits into the context of their daily diet. In recent years, the market has seen a plethora of nutrition indicators on the front panel of the food label, highlighting nutrients that consumers might want to consume more of or those they might want to limit. These FOP nutrient representations can most easily be grouped into two types: 1) Summary and 2) Nutrient-specific
[Andrews et al. 2014] (See Appendix A, Table 1 for examples). Summary indicators are evaluative; that is, they provide an overall interpretive assessment of the healthfulness of a serving of the food, based on a proprietary algorithm. Nutrient-specific indicators, on the other hand, also called “reductive” indicators, are so called because they present a ‘reduced amount’ of the product’s nutrient content on the front of the package.

The scientific literature on FOP nutrition labeling has been the subject of several reviews and reports; we review and summarize them below, and then provide an update of the recent literature (2016 to 2019).

Results of Key Systematic Reviews (2005 to 2016)

A 2005 literature review on consumer understanding and use of nutrition labeling summarized more than 100 studies on NFL usage and FOP nutrition information [Cowburn and Stockley, 2005]. This review was one of the first to conclude that, although consumers report high usage of the NFL, actual usage is likely much lower. The studies reviewed showed that consumers could perform information retrieval tasks and simple calculations using the NFL but it was difficult for them to fully interpret nutrition information on the food label. The review concluded that interpretational aids could contribute to consumers making healthy point-of-purchase choices and moreover, that these aids could help consumers interpret the contribution of the food to the overall diet.

The first large systematic review of FOP nutrient indicators was conducted by the National Academies of Sciences, Engineering, and Medicine (NASEM, formerly the Institute of Medicine (IOM) IOMa, 2010). This report, requested by the U.S. Congress, evaluated the international landscape on FOP nutrition symbols generated by manufacturers, supermarkets, organizations, and governments. The report discusses three types of FOP symbols: 1) Nutrient-Specific Systems; 2) Summary Indicator Systems; and 3) Food Group Information Systems. The overall conclusion was that a FOP rating system or symbol could help consumers identify and select healthy foods, that calories and serving size would be helpful to include in the symbol, and that further testing of consumer use and understanding of “nutrient-specific information” or a “summary indicator” would be necessary. The NASEM report also concluded that a FOP symbol should be geared toward the general population.

The NASEM followed up the report with a Phase II report (IOMb, 2012), focused on consumers’ use of FOP symbols. The Phase II report concluded that, for a FOP symbol to encourage healthier food choices, a simple FOP summary symbol “...that serves as a signal or cue...” would be better than detailed information about nutrient content; the Phase II report recommended “...shifting from an informational approach to an interpretive one...,” and asserted that a successful symbol system would encourage product reformulation or development of products that meet the criteria.

Meanwhile, FDA commissioned a literature review to update the 2005 literature review discussed above. The 2011 FDA review (published by Hersey, et al. 2013) consisted solely of scientific studies on FOP and Shelf Label Nutrition Systems - to learn which types of FOP systems are most effective for influencing healthy food choices. Analysts searched 17 literature databases (e.g., PubMed, Web of Science, ScienceDirect) using a targeted search algorithm. Thirty-eight out of 111 articles were retained for inclusion in the review. This literature review found that summary systems incorporating text and color worked better than those using only numeric information in attracting consumer attention and
getting them to make healthier food choices - but that the nutrient-specific systems (the reductive indicators) worked better than the single summaries for providing consumers with details about what made the food healthy.

In 2016, FDA commissioned an update to the 2011 literature review discussed in the previous paragraph. This update captured the scientific literature on FOP from 2010 to August 2016 (RTI, 2016). Following the format of the previous literature reviews, the Addendum examined 79 articles and summarized them using the same categories identified in earlier reviews. Similar to previous reviews, the Addendum reported that 1) the literature suggests that graphic elements help consumers with food purchase decisions; 2) consumers – especially diverse subpopulations - prefer simple labels over those that have numerical information; 3) color coding with some text leads to better understanding of the nutrition information; 4) there is not enough evidence to indicate exactly which type of FOP label most influences consumers behavior; and 5) there is some evidence that FOP labels influence sales but no evidence on whether they lead to decreasing consumption of nutrients to limit or increasing consumption of nutrients to get enough of.

Results of Key Systematic Reviews (2016 to 2018)

The FDA updated the 2016 FOP literature review by reviewing the scientific literature on FOP from August 2016 to October 2018, using the same targeted database search algorithm and the analytical categories used in earlier reviews. Fifty-one scientific articles on FOP were analyzed for this FOP literature update. Table 1 below presents the highlights and conclusions of this literature review by analytical category.

Table 1. Highlights and Conclusions of updated FOP nutrition labeling literature by analytical category (August 2016 to October 2018)

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<th>ANALYTICAL CATEGORY</th>
<th>HIGHLIGHTS AND CONCLUSIONS</th>
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<td>Attention and Processing</td>
<td>Multiple FOP labeling systems were examined in the identified studies, including: Multiple Traffic Light, Guideline Daily Amounts, 5-Color Nutrition Label (a summary system proposed to France Health Minister, which later was updated to Nutri-Score), Guiding Stars, Health Star Rating, Health checks, NuVal, Logos, and warning signs. Studies have shown that FOPs, health claims, and warnings all drew consumers’ attention. Whether consumers noticed FOPs and how much attention consumers attribute to FOPs varied by different factors (such as the type of FOP, the design of FOP, and the presence of educational effort). Furthermore, the interaction between FOPs and other marketing components on the package was emphasized. One study (De la Cruz-Gongora et al. 2017) found that FOP symbols were perceived as easy to understand, highly acceptable, and useful for decision making, compared to Rating Stars, Guideline Daily Amounts, and Multiple Traffic Light. FOP labels are used differently depending on time pressure. One study (Reis et al. 2016) looked at how time-constraint plays a role in consumers’ attention process and found that while time-constraint did not largely change the way consumers visually processed images of bottled products, it was linked to more fixating time on the information that differentiates among labels (FOP, nutrition claim, and processing...</td>
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<td><strong>Attention and Processing (Cont’d)</strong></td>
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| | claim). Another study (Sanjari et al. 2017) found that time pressure interacts on consumers’ processing mode. 
| **Conclusion:** These studies extend the findings of the 2016 RTI Addendum which found that FOP labels catch consumers’ attention; the newer studies highlighted interactions among a) FOPs, b) other marketing components on the package, and c) time pressure. |
| **Liking, Satisfaction, and Label Preference** | 
| | Our review identified nine studies in this category, with three experimental studies, three cross-sectional surveys, two focus group studies, and one systematic review. 
| | These studies were conducted in different countries, including Australia, France, Uruguay, Germany, and Canada. 
| | Multiple FOP labeling systems were examined in the identified studies, including: Daily Intake Guide, Multiple Traffic Light, Health Star Rating, Nutri-Score (a summary FOP system proposed to the French Health Minister), SENS (a summary FOP system proposed by the French retailers), Modified Reference Intakes, and warnings. 
| | Results from these studies suggest that consumers think FOP labels are more useful than health claims or warnings, and they prefer simple to use and interpretive FOP labels (such as Health Star Rating and Nutri-Score) over others. 
| **Conclusion:** Consistent with 2016 RTI Addendum, results from these recent studies reveal that despite some varied preferences, consumers prefer simple labels, such as the ones using a summary system (e.g., SENS). |
| **Understanding** | 
| | Our review identified 16 studies in this category, with 11 experimental studies, two quasi-experimental study, one focus group study, and one study using sales data and convenience sample survey. 
| | These studies were conducted in different countries, including US, France, Norway, Mexico, Australia, Germany, Brazil, Uruguay, and Canada. 
| | Multiple FOP labeling systems were examined in the identified studies, including: Single and Multiple Traffic Light, Keyhole, Guideline Daily Amounts, 5-Color Nutrition Label (a summary system proposed to France Health Minister, which later was updated to Nutri-Score), Guiding Stars, Health Star Rating, binary check, NuVal, Facts Up Front, logos, and warnings. 
<p>| | Studies found that consumers’ ability to understand different FOPs differed. In general, summary systems (Keyhole, binary check symbol, logos, and rating stars) were easier to understand compared to nutrient specific systems (such as Guideline Daily Amounts). However, one study (Cook et al., 2017) suggested that while a symbol-based (Stars) label helps consumers understand and choose a product in a comparative setting when they elaborate on the importance of nutrition information, the more complex label (Facts Up Front) helps consumers to interpret it when distracted. |</p>
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| Understanding (Cont’d) | Consumers in general lack understanding of various FOPs. However, one study (Julia et al., 2016) showed that when the FOP label was presented with educational information, understanding was improved.  
**Conclusion:** The updated literature review confirms the 2016 RTI findings. Studies indicate FOPs in general can help consumers to understand nutrition information, but to different extents and suggests that the more simplified FOPs are easier for consumers to understand. |
| Effects on Use and Likely Purchase Behavior | Our review identified 23 studies in this category, with 19 experimental studies, two quasi-experimental study, one set of open interviews, and one study using sales data and convenience sample survey.  
These studies were conducted in the US, France, Australia, New Zealand, Uruguay, and Canada.  
Several studies showed that FOP labels led to selections of “mock” foods with better nutrition profiles.  
Several studies showed greater purchase intention for products with FOP symbols versus those without a symbol but one study on willingness to pay found no effects. Some studies found no purchase intention effects.  
FOP symbol rated third behind bottle design and general claims in purchase intention effects. In another study (Georgina, et al, 2017) Health Stars had significant effects (more stars versus fewer) for purchase intentions but the image of the product had a greater effect than the Health Stars.  
**Conclusion:** Studies suggest that FOP nutrition symbols lead to mock ‘purchase’ of foods with better overall nutrition profiles, but results appear to be mixed on experimental and self-assessed purchase intentions; some studies showed significant FOP effects and others did not. |
| Effects on Sales (Purchases) and Consumption | Our review identified 10 studies in this category, with 4 experimental studies, one quasi-experimental study, three qualitative studies using interview methods, two product content analyses, and one study using sales data and a convenience sample survey.  
These studies were conducted in the US, Turkey, New Zealand, Uruguay, and Canada.  
Lesser-known brands, versus brand leaders, showed positive sales effects when bearing FOP nutrition symbol.  
A study on Guiding Stars™ show an increase in product sales for products bearing the symbol.  
Several studies showed evidence of product reformulation toward removal of sat-fat, *trans*-fat, and sodium with FOP implementation. |
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<td><strong>Effects on Sales (Purchases) and Consumption (Cont’d)</strong></td>
<td><strong>Conclusion:</strong> The studies suggest that implementation of FOP Nutrition symbols has led to product reformulations and there is some evidence of increases in sales of products bearing a FOP symbol.</td>
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<td><strong>Effects on Educational Differences</strong></td>
<td>Our review identified 10 studies that measured effects on education, with 4 experimental studies, 5 surveys, 1 set of focus groups, and 1 literature review. (1 study was multi-modal.) These studies were conducted in France, Mexico, Canada, Uruguay, Germany, Australia, and the USA. Summary systems (versus nutrient-descriptive systems) worked best for those with a less deliberative style of making food selections, i.e., those with high nutrition knowledge and those with low nutrition knowledge but high motivation. There were very small differences in preference for certain labels by education; no difference in healthfulness of food choice; understanding, self-reported use, trust. <strong>Conclusion:</strong> Although one study found differences in response to food labels by nutrition knowledge and motivation to eat healthfully, education-level was not revealed to be a significant factor in consumers’ differentiating of FOP labels.</td>
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<td><strong>Effects on Diverse Populations</strong></td>
<td>Our review identified 7 studies in this category, with 4 experimental studies, one set of focus groups and two surveys. These studies were conducted in Uruguay, Mexico, France and Australia. FOP effects seen for low-income children but not for middle and higher income. For children in general (Uruguay), claims and FOP symbols led to increases in understanding of product healthfulness. <strong>Conclusion:</strong> While results from the studies varied, they point toward positive comprehension effects of FOP nutrition information for low-income children.</td>
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<td><strong>Evaluation of Government FOP Nutrition Symbols</strong></td>
<td>One study (Acton, et al., 2018) revealed that when a government attribution was present on a health warning label, it increased the believability of the label and the possible influence on likelihood of purchase. Another study (De la Cruz-Gongora et al., 2017) found that while symbol schemes in general were perceived as easy to understand, highly acceptable, and useful for decision-making, institutional endorsement of logos was related to greater confidence in the label. <strong>Conclusion:</strong> These studies highlighted the potential benefits of having a government-created symbol.</td>
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In January 2019, the World Cancer Research Fund released a report entitled “Building momentum: lessons on implementing a robust front-of-pack food label” that focuses on instructions for government implementation of FOP nutrition labels. Authors conducted a literature review on challenges to international, government implemented nutrition labels and interviewed 23 international policymakers, academics, advocates. With a focus on interpretive FOP labels—which they prefer over nutrient-specific systems - the report contains recommendations for the development, design, implementation, defense, monitoring and evaluation of the FOP. The report recommends governments institute mandatory FOP labels to overcome limited industry uptake but acknowledged that voluntary labels will also help to achieve public health goals by adhering to a process starting with clear policy objectives, knowledge of the legal context, cultivating partners and stakeholders, implementing well-designed public education, and evaluating the labels’ effectiveness post implementation. The report cited challenges to government FOP label implementation - specifically tactics to delay, divide, deflect, and deny.

Additionally, in 2019 the World Health Organization (WHO) released a manual entitled, “WHO guiding principles and framework manual for front-of-pack labelling for promoting healthy diets”. The document is meant to support countries in the development, implementation, and monitoring and evaluation of an appropriate FOP system to help improve dietary patterns and reduce the burden of diet-related noncommunicable diseases. The five overarching guiding principles for FOP that form the basis of the manual are as follows:

- **Principle 1**: The FOP system should be aligned with national public health and nutrition policies and food regulations, as well as with relevant WHO guidance and Codex guidelines.
- **Principle 2**: A single system should be developed to improve the impact of the FOP system.
- **Principle 3**: Mandatory nutrient declarations on food packages are a prerequisite for FOP systems.
- **Principle 4**: A monitoring and review process should be developed as part of the overall FOP system for continuing improvements or adjustments, as required.
- **Principle 5**: The aims, scope, and principles of the FOP system should be transparent and easily accessible.

**Results of Key Systematic Reviews (2018 - 2021)**

Mirroring methods discussed in the previous section, FDA further reviewed the literature, beginning where the last review, conducted August 2016 - October 2018, was completed. The review in this section covers the scientific literature on FOP from November 2018 to August 2021, using the same targeted database search algorithm and the analytical categories used in earlier reviews. We analyzed one hundred and eight additional scientific articles on FOP for this update. Table 2 below presents the highlights and conclusions of this review by analytical category.
Table 2. Highlights and Conclusions of updated FOP nutrition labeling literature by analytical category (November 2018 – August 2021)

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| **Attention and Processing**| Our review identified six studies in this category, including one experimental study, four surveys, and one narrative review.  
These six studies were conducted in Brazil, Italy, and Uruguay. Three studies examined each country respectively, while three others examined FOP systems across all three countries.  
Multiple FOP labeling systems were examined in the identified studies, including Multiple Traffic Light, Nutri-Score, Guidelines Daily Amounts, Facts-up-front, Health Logos, and Warning Labels  
The studies highlighted interactions among: a) FOP labeling systems, b) nutrition information panels on the back or side of packages, c) color and shape, and d) processing time.  
Warning Labels were found to be efficient in attracting consumers’ attention and required less time to process than other FOP schemes (Totora, 2018). One study (Deliza, 2019) found that, although warning signs (also called Warning Labels) are generally attended to by consumers, the familiarity of signs matters. Graphic warning signs that are commonly used to convey a ‘warning message’ outperformed other graphic warning signs in terms of their ability to facilitate the interpretation of nutrition information. Furthermore, black warning signs required significantly less time to be detected, compared to red signs, on color food labels.  
Studies indicate that FOP labels help shoppers to distinguish between healthy and less healthy foods. One review (Temple, 2020) found the designs that appear to be most successful in this regard are Multiple Traffic Light symbols, Warning Labels, and Nutri-Score. Additionally, studies confirm the advantages of Warning Labels, Multiple Traffic Light symbols and Nutri-Score, compared to the GDA, to facilitate the identification of products with high nutrient levels.  
**Conclusion:** These studies extend the findings of the 2016 RTI Addendum, which found that FOP labels catch consumers’ attention. Additionally, one of the studies (Deliza, 2019) suggests that over time, as consumers become more familiar with FOP labels, they will become even more useful. |
| **Liking, Satisfaction, and Label Preference** | Our review identified 12 studies in this category, including three experimental studies, eight cross-sectional surveys, and one focus group study.  
These studies were conducted in eight different countries: Australia, Brazil, Canada, Colombia, Portugal, Spain, the UK, and Uruguay. Two of the studies evaluated multiple countries.  
Multiple FOP labeling systems were examined in the identified studies, including Multiple Traffic Light, Health Star Rating, Nutri-Score, Guidelines Daily Amounts, Warning Labels, Modified Reference Intakes, and logos. |
**Analytical Category** | **Highlights and conclusions**
---|---
**Liking, Satisfaction, and Label Preference (Cont’d)** | Few studies have been conducted to compare participants’ preferences for one type of FOP label over others. One study (Ares, 2020) found consumers have positive attitudes toward nutritional warnings. They were regarded as easy to understand and identify, compared to summary labels (i.e., Multiple Traffic Light symbols or Health Star Rating).

Another study (Talati, 2018) that compared five summary labels across 12 countries suggested that participants preferred the Multiple Traffic Light symbols over other summary labels. Additionally, no meaningful differences were observed between country and FOP type, indicating that culture was not a strong predictor of general perceptions.

However, another study (Dana, 2019) found different forms of FOPs featuring varying degrees of information about energy and specific nutrients were likely to be preferred and used by different market segments. For example, those who are more concerned about their health are more likely to use a FOP label.

Furthermore, an additional study (Pettigrew, 2021) found that participants preferred color versions of summary FOP labels over monochrome versions and those that included nutrient-specific information.

**Conclusion:** Results from these recent studies reveal that additional research should be conducted to determine which type of FOP is preferred by most U.S. consumers. However, based on these findings, it appears consumers prefer simple, color labels, such as the ones using a summary system (i.e., Multiple Traffic Light symbols).

**Understanding** | Our review identified 26 studies in this category, including eight experimental studies, 14 surveys, one focus group study, two systematic reviews, and one narrative review.

These studies were conducted in Belgium, Brazil, Bulgaria, Italy, Mexico, Netherlands, Spain, Switzerland, Thailand, Uruguay, and the United States. Three of the studies assessed findings across several countries.

Multiple FOP systems were examined in the identified studies, including Multiple Traffic Light symbols, Nutri-Score, Health Star Rating, Warning Labels, Reference Intake, and logos.

Studies found that, compared to purely informative systems (i.e., Guideline Daily Amounts), summary/interpretive label systems (i.e., Multiple Traffic Light symbols, Nutri-Score, and Health Star Rating) have the greatest potential to improve consumers’ understanding of the total nutritional quality of foods. One study (Andreeva, 2021) found Nutri-Score is most effective at improving consumers’ abilities to correctly classify food according to its nutritional quality. Additional studies have confirmed the effectiveness of Nutri-Score to aid consumers in their ability to rank products according to nutritional quality (Egnell, 2019).

Studies found that Warning Labels, while less effective at aiding consumers’ understanding of the total nutritional quality of a food, are significantly more effective at helping consumers identify products with excessive amounts of a
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| **Understanding (Cont’d)** | particular nutrient (e.g., sugar, fat, saturated fat, and sodium). One study (Andrews, 2021) found Warning Labels were more effective for evaluating levels of negative nutrients and their associated disease risks compared to the Traffic Light Label (also called Multiple Traffic Light symbols) or no FOP label.

**Conclusion:** The updated literature review confirms the 2016 RTI findings. The adoption and implementation of a uniform FOP labeling system could be beneficial to consumers at the point of purchase, help consumers better understand nutrition information, and therefore could help consumers improve their diet quality leading to a reduction in the incidence of diet-related chronic diseases. The updated literature review also further supports the conclusions of FDA’s previous updated literature review that the summary/interpretable systems are likely to be more effective than purely informative systems in helping consumers understand the total nutritional quality of foods. |
| **Effects on Use & Likely Purchase Behavior** | Our review identified 20 studies in this category, including 10 experimental studies, six surveys, three systematic reviews, and one narrative review.

These studies were conducted in Australia, Belgium, Canada, Chile, France, Israel, Morocco, Peru, Portugal, UK, Uruguay, and the United States. Four of these studies assessed findings across several countries.

Multiple FOP labeling systems were examined in the identified studies, including Multiple Traffic Light symbols, Nutri-Score, Health Star Rating, Guidance Daily Amounts, Warning Labels, Reference Intake, and logos.

These studies found that, compared to the control with no-interpretive-label, FOP labels were effective tools that helped consumers identify healthier food choices. The most effective labels were the Nutri-Score and the Multiple Traffic Light symbols, followed by the Warning Label, the Health Star Rating, and lastly the Reference Intakes (Talati, 2019).

However, there was no robust evidence of superiority of a specific FOP scheme’s effect, either on consumers’ understanding of nutritional content or on food choices.

**Conclusion:** These recent studies suggest that FOP labels are effective at helping consumers identify products with higher nutritional quality and also may be effective at positively impacting consumers’ intent to purchase healthful foods. |
| **Effects on Sales (Purchases) and Consumption** | Our review identified 19 studies in this category, which included 13 experimental studies, three surveys, two systematic reviews and one narrative review.

These studies were conducted in Brazil, Canada, Colombia, France, Singapore, Switzerland, the UK, and the United States. Two of the studies assessed findings across several countries.

Multiple FOP labeling systems were examined in the identified studies, including Multiple Traffic Light symbols, Health Star Rating, Nutri-Score, Warning Labels, SENS (Système d’Étiquetage Nutritionnel Simplifié [simplified nutrition labelling system]), Modified Reference Intakes, and symbols meant to indicate the product meets some “healthy” criteria. |
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<td><strong>Effects on Sales (Purchases) and Consumption (Cont’d)</strong></td>
<td>The use of online/simulated grocery store shelves and access to real-world sales data has enabled researchers to better understand the impact of FOP labels on product consumption. Overall, results show that the presence of FOP labels leads to product purchases. However, not all FOP labels are equally effective. Warning labels, like “High-in” labels have been shown to be most effective at reducing the purchase of products that are high in negative nutrients. In contrast, summary labels, like the Nutri-Score, Multiple Traffic Light symbols, and Health Star Rating were found to be more effective with regard to overall healthy choices. One study from the United Kingdom (Elshiewy, 2018) that examined real-world sales data of store-brand products that carried a voluntary Guidelines Daily Amount type scheme on the front of the food label found that the presence of the scheme resulted in greater sales of products that had fewer calories. Another study (Finkelstein, 2021) found Nutri-Score may be preferred if the goal is to improve overall diet quality, but Multiple Traffic Light symbols may perform better if the goal is to reduce total energy intake. An economics study from France (Egnell, 2019), using data simulations, modeled the sales data of products carrying five different schemes (Nutri-Score, Health Star Rating, Multiple Traffic Lights, Reference intakes, and SENS to dietary intake data to estimate changes in chronic disease mortality by scheme. Results indicated that use of the Nutri-Score scheme led to the greatest estimated reduction in mortality (3.4%). <strong>Conclusion:</strong> These findings suggest that FOPs can influence healthier food purchases in supermarkets and, with prolonged use, may lead to improved health outcomes.</td>
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<td><strong>Effects on Educational Differences</strong></td>
<td>Our review identified two experimental studies that measured effects of FOPs on education and health literacy. The studies were conducted in Canada and the UK. Multiple FOPs were examined, including Multiple Traffic Light symbols, Nutri-Score, Warning Label, Health Star Rating, and Nutrition Facts label. These studies examined the impact of FOPs on participants’ ability to accurately identify the healthfulness of foods. A study (Packer, 2021) that looked at Nutri-Score, Multiple Traffic Lights. Warning Schemes, and a “Positive Choice Tick” (i.e., a symbol indicating the food met some “healthy” criteria), found that, compared to a “no-symbol” food package, participants were able to correctly identify the three-category levels of healthfulness of the food. Further analysis indicated that more highly educated participants, versus those with lower education, identified healthfulness with more accuracy. However, regardless of education level, compared to a “no symbol” control, participants could use the schemes to accurately rank the foods’ healthfulness. Another study (Vanderlee, 2021) that compared Multiple Traffic Lights, Health Star Rating, a Warning Label, and a “no symbol” control found that, to varying degrees, all the schemes helped participants correctly identify the healthier and</td>
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| **Effects on Educational Differences (Cont’d)** | Less healthy products compared to a “no symbol” product. However, there were notable differences between participants with lower health literacy and those with higher health literacy; both groups ranked the product correctly, compared to the “no symbol” condition but those with lower health literacy consistently ranked even the less healthy products as healthier.  
**Conclusion:** Both studies found that interpretive FOP schemes, versus a “no FOP” condition, helped all consumers, regardless of education or health literacy levels, to correctly assess a food’s healthfulness even if some differences between higher and lower education and health literacy were found. |
| **Effects on Diverse Populations (Income, Age, Race/Ethnicity, Minority)** | We identified 14 studies in this category, including eight experimental studies, two sets of focus groups, three surveys, and one systematic literature review.  
These studies were conducted in Australia, Brazil, Chile, France, New Zealand, and Mexico. The systematic literature review included research from multiple countries.  
These studies focused on a range within and between demographic categories and included low- and middle-income populations, parents, children and adolescents, college students, and individuals at risk for obesity and its associated diseases.  
Multiple FOP schemes were evaluated in the studies, including Multiple Traffic Light symbols, Nutri-Score, Guiding Stars, Warning Labels, and Reference Intake Labels.  
Studies found that, compared to no FOP label, all FOP schemes led to these populations selecting foods with a healthier nutrient profile, although between-scheme results were not consistent.  
Nutri-Score appears to have potential to encourage the purchasing of products with higher nutritional quality among a variety of groups. One study (Egnell, 2019) found that students (ages 18-25) purchased more nutritious foods when foods had Nutri-Score labels compared to foods with either the Reference Intakes label or no label. In an additional study (Egnell, 2021), low-income participants purchased more nutritious foods when products had the Nutri-Score label compared to foods with the Reference Intakes label.  
**Conclusion:** While results from the studies varied, they point toward positive effects of FOP labels on consumers’ ability to select healthier products among diverse populations. |
| **Evaluation of Government-Instituted FOP Nutrition Labeling Systems** | Our review identified six studies in this category, with one set of focus groups, three surveys, and one systematic review.  
These studies were conducted in Australia, Denmark, Ecuador, France, and New Zealand.  
These studies focused on a range of FOP schemes developed and instituted by the governments of the study countries. These FOP schemes included Nutritional |
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<th>Analytical Category</th>
<th>Highlights and conclusions</th>
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<tr>
<td>Evaluation of Government-Instituted FOP Nutrition Labeling Systems (Cont’d)</td>
<td>Traffic Light (Ecuador), Nutri-Score (France), Health Star Rating (Australia and New Zealand), the Keyhole (Denmark), and the Whole Grain logo (Denmark). Multiple studies evaluated the course of performance of Australia/New Zealand’s Health Star Rating since its introduction in June 2014. Between 2015 and 2018, consumers’ overall awareness and trust in the Health Star Rating system has increased (e.g., prompted awareness increased from 33% in April 2015 to 84% in July 2018) (Jones, 2019). However, lower awareness is observed in consumers who are overweight, from rural areas, or consumers with lower incomes (Jones, 2019). Furthermore, it was found that better diet quality as defined by the Health Star Rating dietary index was associated with lower risk of all-cause and cardiovascular disease mortality among Australian adults, supporting continued use of the Health Star Rating (Pan, 2020). Findings from other studies include: (1) the use of the Danish FOP schemes (the Keyhole and the Whole Grain logo) was associated with better overall dietary quality, which was driven by lower intake of added sugar and higher intake of fiber (Rønnow, 2020); and (2) study participants in Ecuador showed a high level of knowledge of Nutritional Traffic Light but a low level of usage of this FOP scheme. <strong>Conclusion:</strong> These studies highlighted the potential benefits of having a government-created and sponsored FOP labeling scheme for assisting consumer food choices.</td>
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**Results of Key Systematic Reviews (2021 - 2022)**

FDA further updated the 2018-2021 FOP literature review by reviewing the scientific literature on FOP from January 2021 to August 2022, using a slightly modified version of the targeted database search algorithm but the same analytical categories used in earlier reviews. Because of the proliferation in FOP schemes worldwide since the earlier iterations of this literature review, we included the names of the schemes to the targeted database search algorithms that were used in the 2016-2020 reviews (See highlighted text in Appendix B). We analyzed 77 scientific articles on FOP in the January 2021 to August 2022 FOP literature review update. Table 3 below presents the highlights and conclusions of this literature review by analytical category.
### Table 3. Highlights and conclusions of updated FOP nutrition labeling literature by analytical category (January 2021 – August 2022)

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<th>Analytical Category</th>
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<td><strong>Attention and Processing</strong></td>
<td>Our review identified four experimental studies in this category. These studies were conducted in Chile, France, Portugal, and the United States. FOP labeling systems examined in the identified studies include Facts Up Front, Health Star Rating, Multiple Traffic Light, Nutri-Score, Reference Intakes, and Warning Labels. The studies highlighted interactions among types of FOP schemes, including black-and-white, and colored versions, and nutrition information panels on the back or side of packages. Nearly all FOPs were found to capture attention and improve the ability of participants to estimate healthfulness of products compared to products with no labels. Studies indicate that color FOPs are more effective than black-and-white labels in capturing attention, but that lack of knowledge about the FOP can undermine that effectiveness. One study that compared a 3-category Nutri-Score with a 5-category Nutri-score found that the 5-category scheme resulted in more accurate identification of healthful products, but study participants also spent more time processing the information in the 5-category scheme. <strong>Conclusion:</strong> These studies extend previous findings, which found that FOP labels – particularly those utilizing color – catch consumers’ attention. Also, in keeping with the prior reviews, these studies suggest that familiarity with FOP labels will make them even more useful.</td>
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<td><strong>Liking, Satisfaction, and Label Preference</strong></td>
<td>Our review identified seven studies in this category, with two experimental studies, three surveys, and two focus group studies. These studies were conducted in Australia, Brazil, Chile, China, and India. Two of the studies assessed findings across several countries. FOP labeling systems examined in the identified studies include Health Star Rating, Multiple Traffic Light, Nutri-Score, Reference Intakes, Warning Labels, and pictograms (e.g., teaspoons of sugar). Although few studies compare participants’ preferences for one type of FOP scheme to another, one study (Bhattacharya, 2022) that compared five FOP schemes found Warning Labels to be the most preferred, followed by Multiple Traffic Lights. In studies comparing different types of Warning Labels, one study (Khandpur, 2022) found triangular warning labels to be more useful than those displayed with a magnifying glass, while another (Mazzonetto, 2022) found that most participants preferred black rather than red warning labels regardless of shape.</td>
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<td>Analytical Category</td>
<td>Highlights and conclusions</td>
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<tr>
<td>Liking, Satisfaction, and Label Preference (Cont’d)</td>
<td>Labels communicating teaspoons of sugar, whether in text or pictograms, were perceived as highly factual, relatable, and interpretable, and as having the most potential to influence attitudes and intentions (Miller, 2022b). One study (Septia Irawan, 2022) analyzed Twitter posts concerning FOP labels, and found that the discussion was very limited; Nutri-Score was mentioned most often but with conflicting sentiments. Authors concluded that education programs are needed to educate consumers in order for FOP labels to be useful. A study on stakeholder and consumer perspectives on FOP schemes (Xuejun, 2022) revealed the complexity of reaching consensus for FOP schemes, and that major barriers include agreement on FOP format and the limited knowledge of FOP labelling, pointing again to the need for educating consumers. Conclusion: These current findings reinforce the earlier finding that consumers prefer labels that convey a clear message. However, as with previous reviews, results from these recent studies reveal that the literature is not conclusive about consumer preferences on FOP schemes.</td>
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<tr>
<td>Understanding</td>
<td>Our review identified 16 studies in this category, with two experimental studies and 14 surveys. These studies were conducted in Australia, Brazil, Canada, Chile, China, Ecuador, Greece, Mexico, Netherlands, Slovenia, South Africa, Spain, the United Kingdom, and the United States. Three studies assessed findings across several countries. FOP systems examined in the identified studies include Health Star Rating, Multiple Traffic Light, Nutri-Score, Positive Choice tick, Reference Intakes, Warning Labels, health logos, and NutrInform Battery which has been proposed as an alternative to the EU’s Nutri-Score scheme. Studies continued to support the finding that summary/interpretive label systems (i.e., Multiple Traffic Lights, Nutri-Score and Health Star Rating) offer the greatest potential - compared to purely informative systems - to improve consumers’ understanding of the nutritional quality of foods. Two studies (Packer, 2022; Fialon, 2021) found Nutri-Score performed best at helping consumers rank products according to nutritional quality. A newly introduced FOP, the NutrInform Battery, outperformed Nutri-Score in understanding and comprehensibility (Baccelloni, 2021), presumably because it provides information about nutrients per usual serving. Additional studies confirm the finding that Warning Labels are more effective at helping consumers identify products with excessive amounts of a particular nutrient (i.e., sugar, fat, saturated fat, and sodium). One Chilean study (Mediano Stoltze, 2021) examined consumer perception of the co-occurrence of Warning Labels and nutrient content marketing claims because in Chile the use of nutrient content marketing claims is not prohibited even when the food is required to carry a warning label (due to excessive nutrients to limit) and this could confuse consumers. The study found that Warning Labels can mitigate</td>
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<td>Analytical Category</td>
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<tr>
<td><strong>Understanding (Cont’d)</strong></td>
<td>the “health halo” effect of nutrient content marketing claims on perceived healthfulness of the product.</td>
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<td><strong>Conclusion:</strong></td>
<td>The updated literature review confirms earlier findings and demonstrates that since most FOP labels help consumers understand nutrition quality of a food, the adoption and implementation of a uniform FOP labeling system could be beneficial to consumers.</td>
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<td><strong>Effects on Use &amp; Likely Purchase Behavior</strong></td>
<td>Our review identified 19 studies in this category, with nine experimental studies, six surveys, two systematic reviews, and two narrative reviews.</td>
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<td>These studies were conducted in Australia, Belgium, Brazil, Canada, Columbia, Denmark, France, Germany, Israel, Italy, Mexico, Morocco, Netherlands, Peru, Poland, Portugal, Singapore, Spain, Switzerland, the United Kingdom, Uruguay, and the United States. Four of these studies assessed findings across several countries.</td>
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<td>Multiple FOP labeling systems were examined in the identified studies, including Multiple Traffic Lights, NutriInform Battery, Nutri-Score, Health Star Rating, Guidance Daily Amounts, Warning Labels, Reference Intake, and logos.</td>
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<td>Studies confirm earlier findings showing that compared to control with no interpretive label, FOPs are effective tools to help consumers identify healthier food choices.</td>
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<td>Warning Labels are most effective in helping consumers to identify “high-in...” products, but Nutri-Score and NutriInform Battery were effective in helping to identify the healthiest and unhealthiest products.</td>
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<td>However, robust evidence of superiority of a specific FOP scheme’s effect is still lacking. Studies show disagreement in the ability of a given FOP system to always improve consumers’ understanding of nutritional content or food choices. Several studies found no impact of FOP schemes on purchase intentions (Folkvord, 2021; Muzzioli, 2022; Leão, 2022; Medina-Molina, 2021), while one study (Richetin, 2022) found that the presence of an organic label drives the perception of healthiness, and inclusion of Multiple Traffic Lights did not change that impact.</td>
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<td><strong>Conclusion:</strong> These recent studies suggest that FOP schemes can be effective at helping consumers identify products with higher nutritional quality and can positively impact consumers’ intent to purchase healthful foods, with varying results.</td>
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<td><strong>Effects on Sales (Purchases) and Consumption</strong></td>
<td>Our review identified 12 studies in this category, with 8 experimental studies, one survey, two systematic reviews, and one narrative review.</td>
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<td>These studies were conducted in Australia, Canada, France, Korea, Singapore, Switzerland, the Netherlands, and the United States. Two of the studies assessed findings across several countries.</td>
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| | FOP labeling systems examined in the identified studies include Multiple Traffic Light, Health Star Rating, Nutri-Couleurs (France) Nutri-Repère (France), Nutri-Score, SENS (Système d’Etiquetage Nutritionnel Simplifié [simplified nutrition...
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<th>Analytical Category</th>
<th>Highlights and conclusions</th>
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<td>Effects on Sales (Purchases) and Consumption (Cont’d)</td>
<td>labelling system)), Warning Labels, Modified Reference Intakes, pictograms (e.g., sugar teaspoons), and nutrient content claims. Studies continue to make use of online/simulated grocery store shelves and access to real-world sales data, both of which enable researchers to better understand the impact of FOP labels on product purchase. Overall, there is a positive impact on consumers’ purchases as a result of the presence of FOP labels, with an increase in sales of products with healthier FOP scores and a decrease in sales of products displaying “high in” warning labels, particularly those indicating the product is high in sugar. However, a review examining studies of various FOP (Donini, 2022) found little evidence that clearly correlates FOP labels with health outcomes such as risk of obesity or other non-communicable diseases, primarily due to the lack of any long-term study periods. Not all FOP schemes appear to be equally effective. Warning Labels have shown to be most effective at reducing purchases of products high in a particular nutrient. Depending on the nuanced study specifics summary systems, such as Health Star Rating, Multiple Traffic Lights, and Nutri-Score vary in their ability to discourage purchases of products with high levels of nutrients of concern or in improving overall purchases of healthier products. In one study (Dubois, 2021), sales data from 60 supermarkets showed that consumers who saw products labeled with Nutri-Score increased purchases of foods in the top third (i.e., healthiest) of the food category, but there was no change for purchases with medium, low, or unlabeled nutrient quality. The net result was a modest improvement in the overall nutritional quality of the purchased foods. Another study (Acton, 2021) found that Warning Labels and Multiple Traffic Light symbols were more effective at discouraging purchases of products high in nutrients to limit than positive Health Star Rating or Nutri-Score scores were at encouraging purchases of healthier products. And a third study (Kühne, 2022) found that although FOP labels boosted healthy food product sales, more products and calories were purchased, such that use of the FOP labels did not result in a reduction of calories purchased. Results are somewhat clearer when assessing the impact of FOPs on reducing purchases of products high in added sugar. Studies from Australia (Miller, 2022a), the United States (Taillie, 2022) and a review that assessed findings across several countries (Scapin, 2021) reported that Warning Labels (both text and image-based) increased the likelihood that consumers would identify items high in added sugar. One systematic review (Song, 2021) found that Nutri-Score and Warning Labels were effective in reducing purchases of less healthful products, while Multiple Traffic Light, nutrient warnings, and health warning labels were associated with the purchase of more healthful products. The Nutri-Score and Warning Labels were also associated with increased overall healthfulness of products across all purchases. Color-coded labels performed better at directing consumers toward more healthful products than black-and-white labels. <strong>Conclusion:</strong> These findings suggest that simplified, summary, colorful FOP schemes can encourage healthier purchases in supermarkets but that more research is...</td>
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<td>Analytical Category</td>
<td>Highlights and conclusions</td>
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<tr>
<td><strong>Effects on Sales (Purchases) and Consumption (Cont’d)</strong></td>
<td>needed to demonstrate the ability of FOP schemes with regard to overall health and diet-related chronic disease outcomes.</td>
</tr>
<tr>
<td><strong>Effects on Educational Differences</strong></td>
<td>Our review identified two surveys that measured interactions among FOPs, education, and health literacy. These studies were conducted in Canada and the United Kingdom. The current studies examined the Multiple Traffic Lights and Nutri-Score label systems. These studies examined the impact of education and health knowledge on the extent to which FOP labels affected participants’ ability to accurately identify the healthfulness of foods. While face-to-face education significantly increased participants’ understanding of the Multiple Traffic Lights system, and their knowledge, attitude, and perceptions toward assessing the healthfulness of products displaying these FOPs (Esfandiari, 2021), a study among medical professionals (Riccò, 2022) found that overall understanding was low, with less than half of the participants reporting any knowledge of Nutri-Score. <strong>Conclusion:</strong> These studies highlight the importance of specific FOP labeling education in order to help consumers make informed, healthier choices.</td>
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<tr>
<td><strong>Effects on Diverse Populations</strong></td>
<td>Our review identified 8 studies in this category, with one experimental study, one focus group, and six surveys. These studies were conducted in Australia, Belgium, Canada, Chile, China, France, India, Mexico, New Zealand, Poland, Taiwan, and the United States. These studies focused on a range of populations which included children, adolescents, parents, and students, and also reported results by gender. FOP schemes evaluated in the studies include Guideline Daily Amount, Health Star Rating (both simple and hybrid), Multi-Traffic Light, Nutri-Score, Guiding Stars, Warning Labels (both traditional and numeric), Reference Intake Labels, and health logos. Studies generally found that, among diverse populations, all FOP schemes led to participants making healthier decisions, although one focus group study reported that mothers expressed fatigue with Warning Labels four years after full implementation (Correa, 2022), and suggested the need to identify groups of consumers that could experience similar reactions over time and consider ways to address. Nutri-Score continued to show potential to encourage the purchasing of products with higher nutritional quality among different groups. A variety of age and gender groups reported knowledge and understanding of the Nutri-Score, and demonstrated improved ability to rank food items according to nutritional quality relative to the Reference Intake label (Andreeva, 2022; Ducrot, 2022).</td>
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| Effects on Diverse Populations (Cont’d)                 | Additionally, Nutri-Score was found to be more effective in guiding students with lower health literacy, from non-university institutions, and with low self-estimated nutrition knowledge or low self-estimated diet quality to improve the nutritional quality of their food choices (Hoge, 2022).  
   A study investigating gender differences (Meng, 2022) found men to be more responsive than women to color, while text information on the package affected women’s but not men’s perceptions of product healthfulness.  
   **Conclusion:** While results from the studies varied as in previous reviews, they continue to show generally positive effects of FOP labels on the ability of different populations to select healthier products. Of particular importance are findings on the influence of color and design in helping to inform purchasing decisions of these populations. |
| Evaluation of Government-Instituted FOP Nutrition Symbols | Our review identified three studies in this category, with two narrative reviews and one report from a roundtable.  
   These studies were conducted in Israel, Italy, and the United Kingdom.  
   These studies focused on a range of FOP schemes developed and instituted by the governments of the study countries and provided summaries of government or expert positions on the current usage of FOP labels.  
   These FOP schemes included Health Star Rating, Healthy/Healthier choice, Heart/Health logos, Keyhole logo, Multiple Traffic Light, NutrInform Battery, Nutri-Score, Red and green FOP label, Reference Intakes, and Warning Labels.  
   Since it was introduced, Nutri-Score performance has been evaluated in multiple studies in France, where it was developed, as well as internationally. Nutri-Score has been found to be useful for consumers in determining the healthier choice products, although results are not always consistent. One study and position paper (Carruba, 2021) proposed that Nutri-Score is limited by providing an assessment of nutrient intake based on 100 grams of the product instead of a usual portion. This study suggested that the NutrInform Battery, which was developed in Italy and was intended to help consumers better understand how to improve their dietary choices, may perform better than Nutri-Score. An additional review (SINU Scientific, 2021) concurs, finding that the NutrInform Battery is more focused on helping consumers understand food choices that can lead to a reduction in obesity and non-communicable diseases.  
   Most FOP labels help consumers make informed choices but there is a lack of strong evidence indicating that one particular FOP is clearly superior to the others. The roundtable participants (Gibson-Moore, 2022) recommended using one consistent FOP scheme as an important consideration for ensuring that consumers notice the FOP label, become familiar with it, and develop confidence in its use.  
   **Conclusion:** These studies highlighted the potential benefits of having a government created and mandated FOP labeling system for assisting consumer food choices. |

Overview of Existing Front-of-Package Programs

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<th>Nutrient-Specific Systems</th>
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<td><strong>System Icon</strong></td>
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<tr>
<td><img src="image" alt="Nutrition Highlights" /></td>
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<td><img src="image" alt="Good Source of Calcium" /></td>
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<td><img src="image" alt="Organic" /></td>
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<td><img src="image" alt="Kellogg's Nutrition at a Glance" /></td>
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<td><img src="image" alt="Wegmans Wellness Keys" /></td>
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<td><img src="image" alt="Health Star and Traffic-light System" /></td>
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<td>System Icon</td>
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<td>Nutriscore</td>
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<td>Healthier Choice Symbol</td>
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<td>Multiple Traffic Lights</td>
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<td>UK Traffic Light</td>
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<td><img src="image" alt="American Heart Association Heart Check icon" /></td>
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Appendix B: Methods Report for Systematic Review of Literature on FOP Labeling Including Study Protocol

Introduction

FDA updated the 2016 FOP literature review by reviewing the scientific literature on FOP labeling in four stages. The Phase I literature search covered August 2016 to the end of March 2018. The Phase II search covered the literature from April 2018 to October 2018. The Phase III search covered literature from November 2018 to August 2021. The Phase IV search covered literature from January 2021 to August 2022, in order to capture literature published in early 2021 that may not have been included in databases at the time of the Phase III search. The first three stages used the same targeted database search algorithm and the analytical categories used in the earlier literature reviews for which this project is a follow-on. For the Phase IV search, the database search algorithm was expanded to include the names of the FOP labeling systems identified in the previous three stages.

Objective

Conduct a systematic review of the literature on front of package nutrition labeling/systems/frameworks/symbols/icons since August 2021, using the same search algorithm that had been used for the Hersey, et al (2013), RTI Addendum (2016), and FDA (2021) reviews.

Methods

Articles in English meeting the search criteria and time frame constraints (January 2021 to present for the Phase IV search) were eligible for inclusion in the literature search.

Search Strategy

We searched the following databases: PubMed, Web of Science, ScienceDirect, under which the following databases are subsumed: CHINAHL, Business Source Corporate, PsycINFO, AGRICOLA, Food Science and Technology Abstracts, New York Academy of Medicine Grey Literature Report, NTIS, AgEcon, and CAB Abstracts. The databases Web of Science, CAB Abstracts and New York Academy of Medicine Grey Literature Report, none of which had results in the Phase II or III searches, were not searched in Phase IV.

The following are the search terms used for each database identified above, with the additional terms used in Phase IV indicated by bold type, as well as the number of results returned by database. The first number on the “Results” line is from the Phase I search; the second number, the one in parentheses, is the number returned for the Phase II search; the third number, the one in brackets, is the number returned for the Phase III search, and the fourth number, the one in curly brackets, is the number returned for the Phase IV search. The total number of articles returned in Phases I, II, III and IV searches include many duplicates that were identified and deleted before researchers began the review.
PubMed
Results = 66 (18) [148] {152}

((("front of package nutrition label" OR "front of package nutrition labels" OR "front of pack nutrition label" OR "front of pack nutrition labels" OR "FOP label" OR "FOP labels" OR "front of package label" OR "front of package labels" OR "shelf-labeling" OR "shelf labeling" OR "shelf nutrition label" OR "shelf nutrition labels") AND (consumer OR "consumer behavior" OR "consumer behaviors" OR "consumer preference" OR "consumer preferences" OR "consumer satisfaction" OR "consumer response" OR "consumer responses" OR effective OR design OR designs OR nutrition OR producer OR producers OR retailer OR retailers)) AND ("2021"[Date - Publication] : "3000"[Date - Publication]))) OR ((("Health Star" OR "Traffic Light*" OR "Reference Intakes" OR "Warning symbol" OR "Heart-check" OR "Healthier Choice Symbol" OR "Nutri-Score" OR "Nutri score" OR Nutri-Score OR NuVal) AND label* AND (consumer OR "consumer behavior" OR "consumer behaviors" OR "consumer preference" OR "consumer preferences" OR "consumer satisfaction" OR "consumer response" OR "consumer responses" OR effective OR design OR designs OR nutrition OR producer OR producers OR retailer OR retailers) AND ("2021"[Date - Publication] : "3000"[Date - Publication])))

Web of Science
Results = 22 (0) [0]

(TS="("front of package nutrition label" OR "front of package nutrition labels" OR "front of pack nutrition label" OR "front of pack nutrition labels" OR "FOP label" OR "FOP labels" OR "front of package label" OR "front of package labels" OR "shelf-labeling" OR "shelf labeling" OR "shelf nutrition label" OR "shelf nutrition labels") AND TS=(consumer OR consumers OR "consumer behavior" OR "consumer behaviors" OR "consumer preference" OR "consumer preferences" OR "consumer satisfaction" OR "consumer response" OR "consumer responses" OR effective OR design OR designs OR nutrition OR producer OR producers OR retailer OR retailers))

Science Direct
Results = 0 (advanced search) (3) [39] {45}

Title-Abstr-Key ("front of pack* nutrition label*" OR "FOP label*" OR "front of package label*" OR “shelf labeling” OR “shelf nutrition label*”) AND Title-Abstr-Key (consumer* OR effective OR design* OR nutrition OR producer* OR retailer*) date: 2016-2018

Phase IV search information: Science Direct limits the number of Boolean operators that can be used in any one field at a time to no more than 8. Science Direct also does not support truncation. As a result, searches were conducted as follows:

- Title, abstract, keywords: ("front of pack nutrition label" OR "front of pack nutrition label" OR "front of pack nutrition labeling" OR "front of pack nutrition labeling" OR "front of pack label" OR "front of pack labeling" OR "front of package label" OR "front of package labeling" OR "FOP label") Year: 2021-2022
- Title, abstract, keywords: ("front of pack nutrition labels" OR "front of pack nutrition labels" OR "front of pack labels" OR "front of package labels" OR "FOP labels" OR “FOP labeling”) Year: 2021-2022
• Title, abstract, keywords: ("shelf label" OR "shelf labels" OR "shelf labeling" OR "shelf nutrition label" OR "shelf nutrition labels" OR "shelf nutrition labeling") AND (nutrition OR design OR effective) Year: 2021-2022

• Title, abstract, keywords: ("shelf label" OR "shelf labels" OR "shelf labeling" OR "shelf nutrition label" OR "shelf nutrition labels" OR "shelf nutrition labeling") AND (consumer OR retailer OR producer) Year: 2021-2022

• Title, abstract, keywords: ("Health Star" OR "Traffic Light" OR "Reference Intakes" OR "Warning symbol" OR "Heart-check" OR "Healthier Choice Symbol") AND (label OR labels OR labeling) Year: 2021-2022

• Title, abstract, keywords: ("Nutri-Score" OR "Nutri score" OR Nutri-Score OR NuVal) AND (label OR labels OR labeling) Year: 2021-2022

Food Science and Technology Abstracts
Results = 13 (2) [0] {99}

((("front of package nutrition label" OR "front of package nutrition labels" OR "front of pack nutrition label" OR "front of pack nutrition labels" OR "FOP label" OR "FOP labels" OR "front of package label" OR "front of package labels" OR "shelf-labeling" OR "shelf labeling" OR "shelf nutrition label" OR "shelf nutrition labels") AND (consumer OR consumers OR "consumer behavior" OR "consumer behaviors" OR "consumer preference" OR "consumer preferences" OR "consumer satisfaction" OR "consumer response" OR "consumer responses" OR effective OR design OR designs OR nutrition OR producer OR producers OR retailer OR retailers)) OR ("Health Star" OR "Traffic Light**" OR "Reference Intakes" OR "Warning symbol" OR "Heart-check" OR "Healthier Choice Symbol" OR "Nutri-Score" OR "Nutri score" OR Nutri-Score OR NuVal) AND label* AND (consumer OR consumers OR "consumer behavior" OR "consumer behaviors" OR "consumer satisfaction" OR "consumer response" OR "consumer responses" OR effective OR design OR designs OR nutrition OR producer OR producers OR retailer OR retailers)) AND (pd(20210101-20221231))

CINAHL
Results = 15 (1) [0] {96}

((("front of package nutrition label" OR "front of package nutrition labels" OR "front of pack nutrition label" OR "front of pack nutrition labels" OR "FOP label" OR "FOP labels" OR "front of package label" OR "front of package labels" OR "shelf-labeling" OR "shelf labeling" OR "shelf nutrition label" OR "shelf nutrition labels") AND (consumer OR consumers OR "consumer behavior" OR "consumer behaviors" OR "consumer preference" OR "consumer preferences" OR "consumer satisfaction" OR "consumer response" OR "consumer responses" OR effective OR design OR designs OR nutrition OR producer OR producers OR retailer OR retailers) AND (Limiters - Published Date: 20210101-20221231; English Language)) OR ("Health Star" OR "Traffic Light**" OR "Reference Intakes" OR "Warning symbol" OR "Heart-check" OR "Healthier Choice Symbol" OR "Nutri-Score" OR "Nutri score" OR Nutri-Score OR NuVal) AND label* AND (consumer OR "consumer behavior" OR "consumer behaviors" OR "consumer satisfaction" OR "consumer response" OR "consumer responses" OR effective OR design OR designs OR nutrition OR producer OR producers OR retailer OR retailers) AND (Limiters - Published Date: 20210101-20221231; English Language))
PsycInfo

Results = 7 (0) [0] {21}
(noft("front of package nutrition label" OR "front of package nutrition labels" OR "front of pack
nutrition label" OR "front of pack nutrition labels" OR "FOP label" OR "FOP labels" OR "front of package
label" OR "front of package labels" OR "shelf-labeling" OR "shelf labeling" OR "shelf nutrition label" OR
"shelf nutrition labels") AND ( consumer OR consumers OR “consumer behavior” OR “consumer
behaviors” OR “consumer preference” OR “consumer preferences” OR “consumer satisfaction” OR
"consumer response" OR "consumer responses" OR effective OR design OR designs OR nutrition OR
producer OR producers OR retailer OR retailers))) OR (noft("Health Star" OR "Traffic Light*" OR
"Reference Intakes" OR "Warning symbol" OR "Heart-check" OR "Healthier Choice Symbol" OR
"Nutri-Score" OR "Nutri score" OR Nutri-Score OR NuVal) AND label* AND (consumer OR "consumer
behavior" OR "consumer behaviors" OR "consumer preferences" OR "consumer satisfaction" OR
"consumer response" OR "consumer responses" OR effective OR design OR designs OR nutrition OR
producer OR producers OR retailer OR retailers)) AND pd(2021-2022)

Business Source Complete

Results = 8 (2) [0] {32}
((("front of package nutrition label" OR "front of package nutrition labels" OR "front of pack
nutrition label" OR "front of pack nutrition labels" OR "FOP label" OR "FOP labels" OR "front of package
label" OR "front of package labels" OR "shelf-labeling" OR "shelf labeling" OR “shelf nutrition label” OR
“shelf nutrition labels”) ) AND ( consumer OR consumers OR “consumer behavior” OR “consumer behaviors”
OR “consumer preference” OR “consumer preferences” OR “consumer satisfaction” OR “consumer response"
OR "consumer responses" OR effective OR design OR designs OR nutrition OR producer OR producers OR
retailer OR retailers) AND (Limiters - Published Date: 20210101-20221231; English
language)) OR ("Health Star" OR "Traffic Light*" OR "Reference Intakes" OR "Warning symbol" OR
"Heart-check" OR "Healthier Choice Symbol" OR "Nutri-Score" OR "Nutri score" OR Nutri-Score OR
NuVal) AND label* AND (consumer OR "consumer behavior" OR "consumer behaviors" OR "consumer
preferences" OR "consumer satisfaction" OR "consumer response" OR "consumer responses" OR effective OR design OR
retailer OR retailers) AND (Limiters - Published Date: 20210101-20221231; English Language))

AGRICOLA (Dialog Proquest)

Results = 5 (1) [0] {71}
((ab,ti("front of package nutrition label" OR "front of package nutrition labels" OR "front of pack
nutrition label" OR "front of pack nutrition labels" OR "FOP label" OR "FOP labels" OR "front of package
label" OR "front of package labels" OR "shelf-labeling" OR "shelf labeling" OR “shelf nutrition label” OR
“shelf nutrition labels”) AND ( consumer OR consumers OR “consumer behavior” OR “consumer behaviors”
OR “consumer preference” OR “consumer preferences” OR “consumer satisfaction” OR "consumer response"
OR "consumer responses" OR effective OR design OR designs OR nutrition OR producer OR producers OR
retailer OR retailers)) AND (Limited by: Date: From 2021 to August 2022; Language:English)) OR (ab,ti("Health Star" OR "Traffic Light*" OR "Reference Intakes" OR "Warning symbol" OR
"Heart-check" OR "Healthier Choice Symbol" OR "Nutri-Score" OR "Nutri score" OR Nutri-
Score OR NuVal) AND label* AND (consumer OR "consumer behavior" OR "consumer behaviors" OR "consumer preference" OR "consumer preferences" OR "consumer satisfaction" OR "consumer response" OR "consumer responses" OR effective OR design OR designs OR nutrition OR producer OR producers OR retailer OR retailers) AND (Limited by: Date: From 2021 to August 2022; Language:English)) AND (all(label*))

Cab Abstracts (via ProQuest Dialog)

Results = 14 (0) [0]
("front of package nutrition label" OR "front of package nutrition labels" OR "front of pack nutrition label" OR "front of pack nutrition labels" OR "FOP label" OR "FOP labels" OR "front of package label" OR "front of package labels" OR "shelf-labeling" OR "shelf labeling" OR “shelf nutrition label” OR “shelf nutrition labels”) AND (consumer OR consumers OR "consumer behavior" OR "consumer behaviors" OR "consumer preference" OR "consumer preferences" OR "consumer satisfaction" OR "consumer response" OR "consumer responses" OR effective OR design OR designs OR nutrition OR producer OR producers OR retailer OR retailers)

AgEcon

Results = 18 (0) [0] {3}

Search filter = any field / (date added/modified 01/04/2016 to 31/12/2018)
Results total = 51 (0) removal of duplicates = 33; [1]
front of pack* nutrition label* = 15 (1=2016); [1]
FOP label* = 6 (none 2016-) [0]
front of package label* = 8 (none 2016-) [1, duplicate]
shelf labeling = 8 (only 1=2017) [0]
shelf nutrition label* = 14 (1=2016; 3=2017) [0]

- ("front of package nutrition label" OR "front of package nutrition labels" OR "front of pack nutrition label" OR "front of pack nutrition labels" OR "FOP label" OR "FOP labels" OR "front of package label" OR "front of package labels" OR "shelf-labeling" OR "shelf labeling" OR “shelf nutrition label” OR “shelf nutrition labels”) AND (consumer OR "consumer behavior" OR "consumer behaviors" OR "consumer preference" OR "consumer preferences" OR "consumer satisfaction" OR "consumer response" OR "consumer responses" OR effective OR design OR designs OR nutrition OR producer OR producers OR retailer OR retailers) AND year:2021->2022
- "Health Star" AND year:2021->2022
- "Traffic Light*" AND year:2021->2022
- "Reference Intakes" AND year:2021->2022
- "Warning symbol" AND year:2021->2022
- "Heart-check" AND year:2021->2022
- "Healthier Choice Symbol" AND year:2021->2022
- “Nutri-Score” AND year:2021->2022
- "Nutri score" AND year:2021->2022
- Nutri-Score AND year:2021->2022
- NuVal AND year:2021->2022
No search terms provided for Phase I, II or III. For Phase IV, each labeling term listed below was searched individually. The consumer terms were not used, so as not to limit the search results.

- "front of package nutrition label"
- "front of package nutrition labels"
- "front of pack nutrition label"
- "front of pack nutrition labels"
- "FOP label"
- "FOP labels"
- "front of package label"
- "front of package labels"
- shelf-labeling
- "shelf labeling"
- "shelf nutrition label"
- "shelf nutrition labels"
- "Health Star"
- "Traffic Light*
- "Reference Intakes"
- "Warning symbol"
- "Heart-check"
- "Healthier Choice Symbol"
- "Nutri-Score"
- "Nutri score"
- Nutri-Score
- NuVal
**Phase I (Search period: August 2016 – March 2018)**
Overall, 168 articles were identified in the literature search; 44 duplicates were removed; 36 articles were removed because they were not related to the research topic; 39 additional articles were removed because, 1) upon closer examination they were not related to the research topic, 2) they were already reported in one of the previous literature reviews, or 3) they were duplicates of articles in the review; five articles were removed at the final stage, after the in-depth review because they were determined by both researchers that they were not relevant to the research topic. 44 articles from this stage of search were included in this literature review summary.
**Phase II** *(Search period: April 2018 – October 2018)*
Overall, 80 articles were identified in the literature search; 53 duplicates were removed; 20 articles were further removed because they were not related to the research topic. Seven articles from this stage of search were included in this literature review summary.

**Phase III** *(Search period: November 2018 to August 2021)*
Overall, 187 articles were identified in the literature search; 12 duplicates were removed; 66 articles were further removed because they were not related to the research topic. One article was removed because it was not published in English. One hundred and eight articles from this stage of search were included in this literature review summary.
**Phase IV (Search period: January 2021 to August 2022)**

Overall, 517 articles were identified in the literature search, to which 40 articles were added from FDA’s Web of Science updates, resulting in 557 articles. Of those, 46 articles included in Phase III were removed as well as 224 duplicates and 15 citations for which no publication existed; 200 articles were further removed because they were not related to the research topic (178 removed based on title and abstract review; 22 removed following full text review). Seventy-two articles from this stage of search were included in this literature review summary.

**Mechanism Used to Manage the Review**

Search results were downloaded to- and delivered in- EndNote (20.4.1, Bld 16297), a reference management software program supported by FDA’s reference library.

**Selection Process**

Researchers imported basic information for each of the 94 identified articles identified in Phase IV into Excel, into a file that listed author, year, title, study type, method, sample size, type of FOP, FOP image, country, highlight of findings, and whether the study included “education” as a variable. The articles were divided evenly among five researchers who read them and sorted them into the summary categories that had been used by the prior studies: Attention and processing; Liking, satisfaction, and label preference; Understanding, Effects on use and likely purchase; Effects on sales (purchases and consumption); Effects on Diverse Populations; and Evaluation of Government FOP Nutrition Symbols. At the request of the HSIT, we added a category for Effects on Educational Differences. Researchers also wrote a summary of each article’s findings. These summaries were used to develop overall conclusions by category. The Phase IV reviews were completed by one researcher, who sorted the articles into the same categories used in Phase III and summarized the articles’ findings.
Appendix C: Citations for all References


https://doi.org/10.1080/09637486.2021.1980866

https://doi.org/10.3390/nu14163423

https://doi:10.1108/EJM-10-2021-0764


https://doi.org/10.1108/BFJ-04-2020-0353

https://doi.org/10.1016/j.jbusres.2020.08.062

https://doi.org/10.1002/mar.21601


