Comparing five front-of-pack nutrition labels' influence on consumers' perceptions and purchase intentions

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ABSTRACT

In 2011, a National Academy of Medicine report recommended that packaged food in the U.S. display a uniform front-of-package nutrition label, using a system such as a 0–3 star ranking. Few studies have directly compared this to other labels to determine which best informs consumers and encourages healthier purchases. In 2013, we randomized adult participants (N = 1247) in an Internet-based survey to one of six conditions: no label control; single traffic light; multiple traffic light; Facts Up Front; NuVal; or 0–3 star ranking. We compared groups on purchase intentions and accuracy of participants' interpretation of food labels. There were no differences in the nutritional quality of hypothetical shopping baskets across conditions ($p = 0.845$). All labels improved consumers' abilities to judge the nutritional quality of foods relative to no label, but the best designs varied by outcomes. NuVal and multiple traffic light labels led to the greatest accuracy identifying the healthier of two products ($p < 0.001$), while the multiple traffic light also led to the most accurate estimates of saturated fat, sugar, and sodium ($p < 0.001$). The single traffic light outperformed other labels when participants compared nutrient levels between similar products ($p < 0.03$). Single/multiple traffic light and Facts Up Front labels led to the most accurate calories per serving estimations ($p < 0.001$). Although front-of-package labels helped participants more accurately assess products' nutrition information relative to no label, no conditions shifted adults' purchase intentions. Results did not point to a clearly superior label design, but they suggest that a 3-star label might not be best for educating consumers.

1. Introduction

Policy makers worldwide are interested in cost-effective approaches to address obesity and related chronic diseases. One popular strategy to encourage healthier eating habits is front-of-pack nutrition labeling on packaged food products or labels on supermarket shelves that provide consumers with clear, easy-to-understand nutrition information (Food and Drug Administration, 2009; Institute of Medicine, 2009; Institute of Medicine, 2011). Several countries have implemented different mandatory or voluntary front-of-package labeling systems, including traffic light labels in the U.K. and Ecuador; (Ecuador Ministry of Public Health, 2013) the Choices checkmark in the Netherlands, Czech Republic, Belgium, and Poland; (The Choices Programme, 2017) the Nordic Keyhole symbol; (Swedish National Food Administration, Danish Veterinary and Food Administration, Norwegian Directorate of Health, Norwegian Food Safety Authority, 2012) Health Stars in Australia; (Commonwealth of Australia, 2014) warning labels in Chile; (U.S. Department of Agriculture, Foreign Agriculture Service, 2015) and a "Healthier Choice" label in Singapore (Singapore Government Health Promotion Board, 2017).

In the United States in 2009, the Food and Drug Administration (FDA) launched a front-of-package labeling initiative to promote a science-based, uniform system (Food and Drug Administration, 2009). For this initiative, the Institute of Medicine (now the National Academy of Medicine; NAM) convened a committee recommending the FDA and U.S. Department of Agriculture make healthier options clearer by

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developing a single, standardized front-of-package symbol to translate information from the Nutrition Facts panel. In 2011, the NAM issued a report recommending the symbol appear on all grocery products to maximize its effectiveness by allowing consumers to compare choices within and across categories (Institute of Medicine, 2011). The report provided examples of labeling systems meeting these criteria, including a three-star symbol rating products from less healthy (0 stars) to more healthy (3 stars), modeled after the Energy Star® Program. The U.S. has not yet imposed a mandatory front-of-pack nutrition labeling system, and instead some products display a voluntary system called Facts Up Front, designed and implemented by the food industry (Facts Up Front, 2011).

Prior research has found that certain nutrition label designs are better than others at improving the accuracy of consumers' nutritional judgments of foods (Roberto et al., 2012a; Roberto et al., 2012b). Additional studies demonstrate that point-of-purchase nutrition labels can encourage healthier purchases in cafeterias and supermarkets (Thorndike et al., 2014; Sonnenberg et al., 2013; Cawley et al., 2015; Levy et al., 1985). Although there is some evidence that nutrition labels can influence behaviors, few studies directly compare different label designs to determine which is most effective (Hersey et al., 2013; Watson et al., 2014; Hodgkins et al., 2015). Further, there is little data on the potential influence of the 3-star design proposed in the NAM report, and to our knowledge, no U.S.-based studies that compare it to several common labels.

The objective of this study was to compare the NAM-recommended 3-star labeling system to other common front-of-pack nutrition symbols to determine which is easiest for consumers to understand and use, and which is most likely to influence hypothetical purchasing decisions.

2. Methods

2.1. Study sample

A survey firm (Survey Sampling International (SSI)) used a three-stage process to recruit participants. First, randomly selected participants from SSI's online panels were combined with those recruited through websites and telephone and were invited to take a survey, with no details provided to reduce selection bias. After recruitment, potential participants completed proprietary quality control questions before inclusion in the study. Remaining adults were then randomly assigned to surveys they were likely eligible to complete. This survey was administered in June–July 2013 via Qualtrics, an online survey program. Data were analyzed in March 2017. All participants were at least 18 years old and were recruited such that roughly half the sample would be female and participants would approximate the educational profile of the U.S. based on 2010 Census data. The Harvard T.H. Chan School of Public Health Human Subjects Committee approved this study.

2.2. Label conditions

After participants provided informed consent, they were randomized to one of six front-of-package labels, appearing on food images displayed in Fig. 1:

(1) No front-of-package label (control).
(2) Single Traffic Light - calories per serving label and traffic light symbol (red, yellow, or green) reflecting the product's overall nutritional quality.
(3) Multiple Traffic Light - calories per serving label with traffic light symbol (red, yellow, or green), signifying high/medium/low amounts of saturated fat, sodium, and added sugars, with "High/Med/Low" text within the corresponding traffic light circles.
(4) Facts Up Front – "Facts Up Front" label designed by the food industry (Facts Up Front, 2011) with calories, saturated fat, sodium,

and sugars per serving; nutrient amounts displayed in grams/mg and percent daily value.
(5) NuVal - label developed by a nutrition researcher (Katz et al., 2010) displaying a 1 to 100 score; higher scores indicate healthier products.
(6) 3-Star - label based on a NAM-recommended design displaying calorie information plus a zero (least healthy) to three (most healthy) star rating, signifying amounts of saturated/*trans* fats, sodium, and added sugars.

We hypothesized that all labels would increase consumer understanding of the nutritional quality of packaged foods and encourage healthier hypothetical purchases relative to no label. Based on previous findings (Roberto et al., 2012a; Roberto et al., 2012b), we also hypothesized that traffic light labels would lead to the most accurate judgments of the nutritional content of packaged foods and the healthiest hypothetical food choices. Such labels should be easily processed because color coding makes them salient, and they leverage automatic associations between "red: stop" and "green: go." In addition, other research found using "High/Med/Low" text helped consumers better understand labels (Malam et al., 2009). In contrast, we predicted that labeling systems with only numeric information (NuVal, Facts Up Front) would perform worst because they display numbers and/or percentages that require greater cognitive engagement and lack features that would increase saliency (e.g., colors, images). Finally, we predicted that the 3-star symbol would perform better than numeric labels because it uses a simple symbolic presentation rather than numeric information, but worse than traffic light labels because it may be less intuitive and salient than color coded traffic lights. Further, although 1–5 star ranking systems are common (e.g., Amazon and Yelp), the 0–3 star system may be less familiar to consumers.

2.3. Nutrition criteria for labeling systems

Nutrition information for all products was obtained from the Nutrition Facts panel on food packaging or from food manufacturer websites. To test the effectiveness of the front-of-package label design, rather than the underlying nutrition criteria, we used the same nutrient profile model algorithm to assign all foods a healthfulness score (Rayner et al., 2005). The Nutrient Profile Model is an algorithm that adds points for calories and negative nutrients (saturated fat, sugar, sodium), and subtracts points for positive nutrients (fiber, protein) and the percentage of fruit, vegetables, or nuts (not included in calculations because products in this study had minimal amounts) (Lobstein and Davies, 2009). This model has been validated by nutritionists (Lobstein and Davies, 2009; Scarborough et al., 2007; Arambepola et al., 2007) and is used to inform food policies in the U.K. and Australia (Food Standards Australia and New Zealand, 2016; United Kingdom Department of Health, 2011). Consistent with other research (Bragg et al., 2013; Bragg et al., 2012), the nutrient profile model score was converted to a Nutrient Profile Index (NPI) to improve interpretability using the formula: [NPI score = $(-2) \times$ NPM score + 70], where 1 is the worst possible nutrition score and 100 is the best score (Rayner et al., 2005). One limitation of the NPM is that it scores most sugar-sweetened beverages similarly because sugar is the only nutrient. Therefore, for beverages, we used caloric content as a measure of healthfulness, rather than NPI score, to produce more variability across products. *Supplementary Table 1* presents NPI scores for foods and calories for beverages used in the shopping task. For the multiple traffic light system, nutrients were labeled high, medium, or low, based on the UK Food Standards Agency's cut-offs for the NPI (Rayner et al., 2005).

2.4. Survey procedure and main outcomes

2.4.1. Shopping basket score

After providing consent, participants were randomized to a label