



# The Impact of Variations in a Fact-Based Front-of-Package Nutrition Labeling System on Consumer Comprehension<sup>☆</sup>

**I**N 1990, WHEN THE NUTRITION Labeling and Education Act<sup>1</sup> was enacted, there was a clear need for standardized information on food product packaging. This legislation, an amendment of the Federal Food, Drug and Cosmetic Act of 1938,<sup>2</sup> was intended to enable consumers to make more informed food choices to build a healthy diet. In addition to the new requirement for nutrition labeling on most packaged foods, and the creation of uniform definitions used in nutrient content claims, the Nutrition Labeling and Education Act revised health claim regulations allowing manufacturers to print approved health claims on the front of food and beverage product packaging if certain criteria were met.

The American Heart Association's Heart-Check Food Certification Program,<sup>3</sup>

launched in 1995, was among the first front-of-package labeling systems. Participating manufacturers who had submitted an application and received approval could place an American Heart Association Heart Check on the front of package if the food met US Food and Drug Administration (FDA) regulations for a heart health claim<sup>4</sup> and American Heart Association's specific criteria.

Consumer interest in understanding how to identify healthful foods continues to increase,<sup>5-7</sup> as manufacturers and retailers have been adding interpretive symbols and fact-based icons (collectively known as "systems") to product packages and shelf tags. Although these systems were created to help consumers make informed, healthful food choices, the formats, colors, and amount and type of information provided, including summary nutrition ratings, nutrient-specific disclosures about public health concerns, and dietary recommendations, often varied.<sup>8-15</sup>

The FDA addressed this reality in 2007 via public hearings and requested research on the effectiveness of front-of-package systems.<sup>16,17</sup> In 2009, Congress directed the Centers for Disease Control and Prevention to evaluate and make recommendations about front-of-package systems and symbols.<sup>18,19</sup> The Centers for Disease Control and Prevention joined forces with the FDA and US Department of Agriculture to commission the Institute of Medicine to address this charge. The resulting Phase I report by the Institute of Medicine in 2010<sup>20</sup> noted that more work was needed to determine appropriate criteria for front-of-package labeling systems and how best to convey information in such systems. Subsequent to the completion of the study presented in this article, the Institute of Medicine Phase II report<sup>21</sup> was published, which recommended development and consumer testing of a single, interpretive

symbol for the front-of-package combined with fact-based calorie and serving size information.

The importance of helping consumers make informed food choices and select a healthful diet has never been more vital because the incidence of diet-related disease persists. Obesity is increasing again after reaching a plateau in 2008,<sup>22,23</sup> as is diabetes.<sup>24\*</sup> Because nutrition information on food product packaging is among the factors that affect consumer purchase decisions<sup>5,6</sup>—72% of consumers reported seeing the front-of-package symbols or icons and 67% reported they used symbols or icons to inform a food product purchase decision<sup>9</sup>—and there is a wide range of systems with varying criteria, consumer research is needed to determine an easy-to-use, understandable, accessible format.<sup>16,17</sup> Dietetics practitioners' understanding of outcomes of labeling system research is important, given their critical role in helping consumers make healthful food choices.

The International Food Information Council Foundation designed a study to examine consumer comprehension, ease of understanding, and interpretation of nutrition information in the uniformly formatted, voluntary front-of-package labeling system that was under consideration by the Grocery Manufacturers Association and the Food Marketing Institute. This research was used to inform the framework for the Facts Up Front<sup>25</sup> program, which is currently implemented by the two groups.

\*According to 2010 Centers for Disease Control and Prevention data, 28.5 million people, or 8.3% of the US population, have diabetes (18.8 million diagnosed, estimated 7 million undiagnosed), and 35.7% of the US adult population and 17% (12.5 million) of children aged 2 to 19 years are obese.

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#### Supplementary materials:

Tables 1, 2, and 3 available at [www.andjrn.org](http://www.andjrn.org)  
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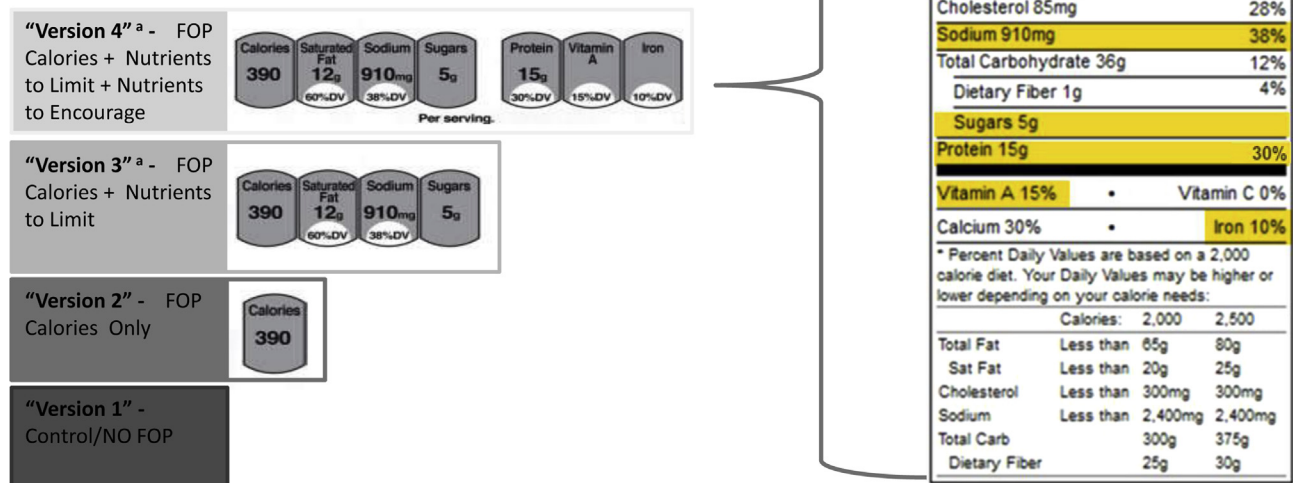
## APPROACH

From August 14 to October 12, 2010, a professional marketing research firm, contracted by the International Food Information Council Foundation, conducted an interactive online survey of primary grocery shoppers. The sample was drawn from a web panel of >4,000,000 people representing hundreds of demographic, socioeconomic, and lifestyle attributes.

The sample, 7,363 men and women aged 18 to 70 years, was screened to be reflective of the US population (2007-2008 US Census estimates)<sup>26</sup> with respect to household income, age, and education level (Table 1, available online at [www.andjrn.org](http://www.andjrn.org)). Participants were required to have purchased and consumed both product types from one of two groupings—breakfast cereals and frozen entrées, or salad dressings and savory snacks—within the past 3 months. Respondents received an incentive for participation.

This survey evaluated the relative effectiveness of four versions of front-of-package nutrition information in one consistently formatted, fact-based system (Figure 1) that mirrors several aspects of the Nutrition Facts label, including use of a neutral background with black print, and focused on nutrients to encourage or limit, per the 2005 Dietary Guidelines for Americans<sup>27</sup> (Figures 1 and 2). This system complied with the current Code of Federal Regulations for nutrition labeling.<sup>4</sup> Using a fact-based system that presents nutrient values without value judgment helped to ensure that the information would not be deemed misleading. Products were obtained from grocery store shelves. To avoid participant bias for or against particular brands, evidence of branding was removed from product packaging. The serving sizes and the Nutrition Facts label were reviewed to ensure compliance with food labeling regulations.<sup>4</sup> Version 1

served as the control, displaying no nutrition information on the front of package (Figure 1). Version 2 displayed only calories on the front of package. Version 3 displayed calories and three nutrients to limit (saturated fat, sodium, and sugars) on the front of package. Finally, version 4 displayed calories, three nutrients to limit, and either one nutrient to encourage on savory snack and salad dressing products, or three nutrients to encourage on cereal and frozen entrée products. In order to be displayed on the front of package, nutrients to encourage are required by food labeling regulations to meet at least 10% of the Daily Value (DV). Therefore, with nutrient variability from product to product, it was necessary to display different nutrients to encourage on different products, and to display only one nutrient to encourage on savory snacks and salad dressings (Figure 2, footnote c).



<sup>a</sup>Nutrients to limit (saturated fat, sodium, and sugars) are those that, if overconsumed, potentially increase one’s risk of chronic disease; nutrients to encourage (protein, vitamin A, and iron) are those that contribute to a nutrient-dense diet, are underconsumed in a typical US diet (2005 Dietary Guidelines for Americans),<sup>27</sup> or that are required on the Nutrition Facts label (21 CFR 101.9).<sup>4</sup>

**Figure 1.** Front-of-package labeling system (refers to the front-of-package versions tested in the survey).

## Questionnaire Description

The 7,363 participants were randomly assigned to view and answer questions about only one of the four front-of-package versions displayed on six products within one set of product categories (ie, breakfast cereals and frozen entrées, or salad dressings and savory snacks). The resulting groups were found to be demographically similar (Table 1, available online at [www.andjrn.org](http://www.andjrn.org)). The product category pairings allowed respondents assigned to version 4 to see comparable numbers of icons for nutrients to encourage. Three products in each category represented three “tiers” of nutritional content—those meeting higher, medium, and lower levels of nutrients to encourage or limit (Figure 2). (Note: The tiers were not identified for participants.) Within each section, the order of products presented and questions asked was rotated.

The questionnaire was tested to confirm rotating and skipping patterns worked correctly. It was field tested with 800 subjects to ensure survey language was understood by respondents and to assess internal validity and directionality. Deemed valid, these 800 interviews were used as part of the total sample.

The questionnaire contained fill-in-the-blank, multiple choice, rating, and open-ended questions. Respondents had to acknowledge receipt of the marketing firm’s privacy/confidentiality policy before participating. Participants were informed that their names and responses would remain confidential and study results would be reported in total. The questionnaire began with demographic, socioeconomic, and shopping questions (Table 1, available online at [www.andjrn.org](http://www.andjrn.org)), which doubled as a screening device.

For one product in each category, five questions addressed identification of nutrient amounts; four questions addressed %DV per serving (Table 2, available online at [www.andjrn.org](http://www.andjrn.org)); two questions addressed product comparisons (Table 3, available online at [www.andjrn.org](http://www.andjrn.org)); and four questions asked about ease of answering identification and comparison questions (Table 4). Participants next answered a multiple-choice question about which product (one of three in the category) they perceived was the best choice with respect to nutritional value (Table 3,

available online at [www.andjrn.org](http://www.andjrn.org)); in an open-ended question, respondents were asked to explain their rationale.

Respondents rated the front-of-package icon versions on a 5-point scale (where 1=strongly disagree and 5=strongly agree) regarding eight attributes, such as whether the front-of-package information was helpful in making an informed decision (Table 5). Finally, participants answered multiple-choice questions about shopping behaviors and health concerns for their families (Table 1, available online at [www.andjrn.org](http://www.andjrn.org)). Respondents were informed that they had access (via mouse click) to the Nutrition Facts label on the back of the package if they wished to view it.

## Statistics

Descriptive statistics were performed on all variables and statistical analyses were conducted using Quantum software, version 5.8.1 (2010, IBM). Responses to comprehension, ease of use, and interpretation questions about front-of-package versions were compared using a *t* test on column proportions. Responses to comprehension by education level were compared using a *t* test on means. The *P* level was set at 0.05.

## FINDING

### Participant Description and Food Label Behaviors

Of 25,922 consumers who started the survey and were assigned to a front-of-package version, 7,363 (28%) completed it. Mean completion time was 19 minutes ( $\pm 8.8$  minutes standard deviation). If participants took <10 minutes or >45 minutes to complete the survey, their responses were excluded from analysis. There were no significant differences regarding demographics and socioeconomic characteristics among participants assigned to each front-of-package version (Table 1, available online at [www.andjrn.org](http://www.andjrn.org)).

Overall, 86% of respondents self-reported that they read a product’s Nutrition Facts label regularly or occasionally when purchasing it for the first time; 85% self-reported reading labels to compare nutritional values (Table 1, available online at [www.andjrn.org](http://www.andjrn.org)). Among respondents who rarely or never used labels for purchasing

decisions, nearly half (48%) were in the lowest income group (<\$35,000), 21% had less than a high school education, and 38% had attained a high school education or its equivalent. Regular label users were significantly more likely to be college educated ( $P < 0.05$ ).

Regarding health concerns for themselves or their families, respondents indicated obesity/overweight was their top health concern, followed by high cholesterol, high blood pressure, and diabetes.

**Increasing Shoppers’ Comprehension.** Nine questions assessed respondents’ ability to identify absolute numbers (eg, 140 kcal) for nutrient values and %DVs of each product, for a total of 18 questions per respondent. More nutrition information on the front-of-package generally strengthened consumers’ comprehension (Table 2, available online at [www.andjrn.org](http://www.andjrn.org)).

**Identifying Nutrient Amounts and %DV by Product Category.** Consumers accurately identified nutritional content more frequently when the relevant information was available on the front of package. For those assigned to different front-of-package versions for breakfast cereals, for example, the total percentage of correct answers to five questions regarding absolute numbers for nutrient values ranged from 87% to 96% and was not significantly different across versions (Table 2, available online at [www.andjrn.org](http://www.andjrn.org)); however, analyzing each question individually, consumers demonstrated significantly increased comprehension when more information was provided. That is, respondents assigned to version 4 had significantly higher correct response rates about absolute values of sodium, saturated fat, sugar, and fiber than respondents assigned to versions 1 and 2. The same finding was observed in the four questions about %DV in breakfast cereals: understanding %DVs for sodium, saturated fat, fiber, and folate was significantly higher among respondents assigned to version 4 than those assigned to versions 1 to 3. Similar results were found for frozen entrées. Scoring for questions regarding the protein grams and the %DV for sodium, vitamin A, and iron was higher among respondents assigned to version 4 compared with respondents assigned to

Attributes and characteristics of front-of-package versions	Level	Description
Load <sup>a</sup>		
	Version 1: Control	No front-of-package information: Zero icons
Aligns with US Food and Drug Administration proposal to make calories more prominent on label <sup>28</sup>	Version 2: Some information	Calories only: One icon
Aligns with the 2005 Dietary Guidelines for Americans <sup>27</sup>	Version 3: More information	Calories+nutrients to limit <sup>b</sup> (saturated fat, sodium, and sugars): Four icons
Aligns with the 2005 Dietary Guidelines for Americans for nutrients to encourage or limit <sup>27</sup> or the Code of Federal Regulations for required nutrients on the Nutrition Facts label <sup>4</sup>	Version 4: Most information	Calories+nutrients to limit <sup>b</sup> (saturated fat, sodium, and sugars) and nutrients to encourage <sup>c</sup> (protein, fiber, vitamin A, vitamin C, calcium, iron, or folate): Five to seven icons
Product packaging tested <sup>d</sup>		
Products used to display front-of-package nutrient information were consistent with the products the US Food and Drug Administration used in its study methodology <sup>29,30</sup>	Breakfast cereals	Product 1: Bran flakes (enriched bran flakes cereal) Product 2: Crispy honey oats and flakes with almonds (frosted corn and wheat flakes with rolled oat and granola clusters and almonds) Product 3: Bunch of cinnamon squares (sweetened wheat and rice cereal) Nutrients to encourage: fiber, vitamin A, and folate
	Frozen entrées	Product 1: Sesame chicken (seasoned, white meat chicken on a bed of noodles with green beans and red bell peppers) Product 2: Cheese manicotti (in a meaty marinara sauce, topped with mozzarella and parmesan cheeses) Product 3: Homestyle macaroni and cheese bake (sharp cheddar cheese, macaroni, and bread crumb topping) Nutrients to encourage: protein, vitamin A, and iron
	Salad dressings	Product 1: Classic Italian—Nutrient to encourage: Vitamin C Product 2: Deluxe French—Nutrient to encourage: Vitamin A Product 3: Chunky blue cheese—Nutrient to encourage: Calcium
	Savory snacks	Product 1: Multigrain tortilla chips (authentic style)—Nutrient to encourage: Iron Product 2: Potato chips (classic)—Nutrient to encourage: Vitamin C Product 3: Popcorn (salted)—Nutrient to encourage: Iron
<i>(continued on next page)</i>		

**Figure 2.** Rationale and description of information on the four versions of the front-of-package icon system for four product categories for an interactive online survey of primary grocery shoppers.

Attributes and characteristics of front-of-package versions	Level	Description
<b>Nutrition information tiers</b>		
Consistent with FDA methodology, <sup>29,30</sup> nutrient levels printed on the labels were adjusted (rounded up or down) to clarify high/medium/and low levels of calories and nutrients to encourage represented at least 10% of the DV within product feasibility	Product 1	Lower in calories, saturated fat, total sugars, and sodium Higher (good source) in vitamins, minerals, protein, and/or fiber
	Product 2	Mid-level in nutrient content
	Product 3	Highest in nutrients that should be limited and lowest in nutrients that should be encouraged
<b>Color</b>		
Color was not used for front-of-package icons in order to prevent bias	Black, white, and gray	Used for the icons to coordinate with the Nutrition Facts label <sup>4</sup> and to present the information in a neutral/nonbiased, factual format
<b>Presentation of nutrition information</b>		
Presentation and order of information aligned with the Code of Federal Regulations for presenting information on the Nutrition Facts label <sup>4</sup>	Absolute numbers	Calories and sugars
	Percent of Daily Value	Vitamin A, vitamin C, calcium, iron, and folate
	Absolute numbers and percent of Daily Value	Saturated fat, sodium, fiber, and protein

<sup>a</sup>All versions presented Nutrition Facts label information. Presentation of the information on the front of package required that the same nutrients be included in the Nutrition Facts label.

<sup>b</sup>Nutrients to limit did not include *trans* fat. In 2003, the US Food and Drug Administration began requiring that *trans* fat be included in the Nutrition Facts label.<sup>31</sup> As a result, most products were reformulated to decrease or eliminate it. Therefore, the amount in the food supply was negligible and the amount indicated likely would be zero.

<sup>c</sup>Nutrients to encourage varied by product: fiber, vitamin A, and folate for breakfast cereals; protein, iron, and vitamin A for frozen entrées; vitamin A, vitamin C, or calcium for salad dressings; and vitamin C or iron for savory snacks. Nutrients to encourage on the front of package had to meet the definition of a “good source” of the nutrient (ie, contain at least 10% of the Daily Value).<sup>4</sup>

<sup>d</sup>All products were actual products. All front-of-package labeling not related to the front-of-package icon scheme tested, including brand name and any claims, was removed to prevent bias. The name of the product was included. Screen shots included both the front and back panels of the products.

**Figure 2.** (continued) Rationale and description of information on the four versions of the front-of-package icon system for four product categories for an interactive online survey of primary grocery shoppers.

version 3 (Table 2, available online at [www.andjrn.org](http://www.andjrn.org)).

For salad dressings, identification of cholesterol milligrams and %DV for vitamins A and C was higher in versions 1 and 2 than in versions 3 and

4 (Table 2, available online at [www.andjrn.org](http://www.andjrn.org)). Unlike breakfast cereals and frozen entrées, the front of package for salad dressings in version 4 displayed the answer to only six questions rather than all eight; information

about cholesterol values was available to these respondents only via the Nutrition Facts label and the %DV for vitamins A and C was available only via the front of package to one third of these respondents.

**Table 4.** Percentage of primary household grocery shopper respondents reporting use of four versions of the front-of-package system for four food categories as “very easy”<sup>a</sup> in an interactive online survey (n=7,363)<sup>bc</sup>

Key evaluation measures	Percentage of Total Sample Who Reported “Very Easy” <sup>a</sup>			
	Version 1: None (n = 1,832)	Version 2: Calories only (n = 1,850)	Version 3: Calories + nutrients to limit <sup>d</sup> (n = 1,830)	Version 4: Calories + nutrients to limit <sup>d</sup> + nutrients to encourage <sup>e</sup> (n = 1,851)
	←-----%-----→			
<b>Breakfast cereals</b>				
Nutrition information (on 1 package)	71	71	74	82 <sup>xyz</sup>
% DV <sup>f</sup> nutrition information (on 1 package)	78	79	75	90 <sup>xyz</sup>
Lowest calories per serving (among 3 packages)	86	90 <sup>x</sup>	90 <sup>x</sup>	92 <sup>x</sup>
Lowest sodium per serving (among 3 packages)	83	80	88 <sup>xy</sup>	91 <sup>xy</sup>
<b>Frozen entrées</b>				
Nutrition information (on 1 package)	82	82	87 <sup>xy</sup>	96 <sup>xyz</sup>
%DV nutrition information (on 1 package)	78	79	81	94 <sup>xyz</sup>
Lowest calories per serving (among 3 packages)	86	91 <sup>x</sup>	92 <sup>x</sup>	93 <sup>x</sup>
Lowest sodium per serving (among 3 packages)	86 <sup>y</sup>	80	92 <sup>xy</sup>	94 <sup>xy</sup>
<b>Salad dressings</b>				
Nutrition information (on 1 package)	92	93	94 <sup>x</sup>	95 <sup>xy</sup>
%DV nutrition information (on 1 package)	88	90 <sup>z</sup>	87	88
Lowest calories per serving (among 3 packages)	89	95 <sup>x</sup>	95 <sup>x</sup>	93 <sup>x</sup>
Lowest sodium per serving (among 3 packages)	87	88	93 <sup>xy</sup>	92 <sup>xy</sup>
<b>Savory snacks</b>				
Nutrition information (on 1 package)	91	93 <sup>x</sup>	94 <sup>x</sup>	94 <sup>x</sup>
%DV nutrition information (on 1 package)	86	88	87	91 <sup>xz</sup>
Lowest calories per serving (among 3 packages)	86	88	91 <sup>xy</sup>	91 <sup>xy</sup>
Lowest sodium per serving (among 3 packages)	86	86	91 <sup>xy</sup>	91 <sup>xy</sup>

<sup>a</sup>The question was stated as follows: “In general, how easy was it for you to figure out the answers you provided for the previous series of questions (eg, number of calories per serving, number of grams of fiber per serving, etc)? Very easy to figure out; somewhat easy to figure out; not too easy to figure out; not at all easy to figure out.”

<sup>b</sup>Survey respondents (n=7,363) were randomized to view and answer questions about six products within two of four product categories (breakfast cereals and frozen entrées or salad dressings and savory snacks) that specifically displayed only one of the four available front-of-package versions.

<sup>c</sup>Front-of-package versions varied in amount and type of information: version 1 contained no front-of-package information and version 4 contained the most front-of-package information.

<sup>d</sup>Nutrients to limit: saturated fat, sodium, and total sugars.

<sup>e</sup>Nutrients to encourage: fiber, vitamin A, and folate for breakfast cereals; protein, vitamin A, and iron for frozen entrées; vitamin A, vitamin C, or calcium for salad dressings; and vitamin C or iron for savory snacks.

<sup>f</sup>%DV=percent daily value.

<sup>x</sup>Significantly different from version 1 at P<0.05. Comparisons are made horizontally.

<sup>y</sup>Significantly different from version 2 at P<0.05. Comparisons are made horizontally.

<sup>z</sup>Significantly different from version 3 at P<0.05. Comparisons are made horizontally.

For savory snacks, respondents' correct answers for version 4 were significantly higher than for version 1 for six of the nine questions. Exceptions included protein grams and %DV for vitamin C and iron (Table 2, available online at [www.andjrn.org](http://www.andjrn.org)). The difference was only 3% for vitamin C, but 8% for protein. Protein grams did not appear on the version 4 front of package; therefore, the answer to the question was available only via the Nutrition Facts label. Vitamin C appeared on only one third of the version 4 savory snacks (as noted, one positive nutrient was displayed on each product in this category). Participants showed no difference in identifying the %DV for iron with versions 1, 2, or 4. However, those who viewed version 3 (calories plus nutrients to limit) were less likely to correctly identify nutrients to encourage.

Initial use of the Nutrition Facts label dropped significantly ( $P < 0.05$ ) when more front-of-package information was displayed. More individuals (63%) who viewed version 1 and version 2 (57%) read the Nutrition Facts label than respondents viewing versions 3 (46%) and 4 (45%).

**Identifying Products with the Lowest or Highest Nutritional Value and Best Perceived Nutritional Value by Product Category.** Correct identification of products with the lowest number of calories per serving was somewhat mixed by product category (Table 3, available online at [www.andjrn.org](http://www.andjrn.org)). But respondents scored higher with versions 2, 3, or 4 compared with version 1, even though the Nutrition Facts label was always available.

When identifying products with the highest or lowest amount of sodium, participants evaluating breakfast cereals, frozen entrées, and savory snacks had a significantly higher percentage of correct responses for versions 3 and/or 4, which included sodium information; for salad dressings, respondents' scores for versions 2 to 4 were significantly higher than for version 1 (Table 3, available online at [www.andjrn.org](http://www.andjrn.org)).

With regard to perceived best nutritional value among three products in a category, participants evaluating versions 2 and 4 for breakfast cereal were significantly more likely to answer correctly than those evaluating

version 3 (Table 3, available online at [www.andjrn.org](http://www.andjrn.org)). In contrast, for frozen entrées, version 3 respondents performed better than those evaluating versions 1 or 4. For salad dressings, version 3 participants performed better than those viewing version 1. Among individuals evaluating savory snacks, there were no significant differences across versions in perceived best nutritional value.

When respondents were asked about their rationale for best product choices, answers varied by product type based on nutrient composition (data not shown). Large percentages of respondents within all product categories made selections based on lower amounts of "nutrients to limit" (eg, sodium and saturated fat); however, for breakfast cereals and savory snacks, participants' rationale was often related to more "nutrients to encourage," for example, fiber and protein, in the product.

### More Nutrient Information Increased Ease of Understanding and Interpretation

**Ratings Ease of Understanding.** Ratings about ease of answering questions were generally significantly higher among participants who evaluated front-of-package labels with more information (versions 3 and/or 4) than those who evaluated front-of-package labels with some or no information (Table 4). In one notable exception, for all products where the front of package included calorie information, respondents reported greater ease of answering questions about lowest calories per serving. Representing another exception, salad dressings rated higher for ease of answering questions about %DV with version 2 than with version 4.

**Interpretation.** Respondents were asked to evaluate the front-of-package nutrition information regarding eight interpretation attributes (Table 5). The percentage of participants who strongly agreed or agreed that the front-of-package's nutrition information (across all four product categories) helped them make an informed decision was significantly higher for version 3 and 4 respondents than for version 2 respondents. This same outcome was noted when participants rated whether

the information was easy to understand and should be included on other food product packaging. Regardless of food category, all version 2 participants strongly agreed that the front-of-package "does not include enough important information."

### Increasing Nutrient Information on Front of Package Improved Comprehension at All Educational Levels

**Comprehension.** When data were segmented by socioeconomic variables, only education level had any consistent, significant impact on comprehension. More front-of-package information improved comprehension scores at all education levels for breakfast cereals and frozen entrées (Table 6).

Notably, more information also improved comprehension scores for those assigned to salad dressings and savory snacks, but only for those with some high school or less. Those with higher levels of education scored higher on version 1 questions; therefore, the difference in scores between versions 1 and 4 was not large enough to show a significant difference in comprehension.

### INTERPRETING THE WEB-SURVEY FINDINGS

The purpose of food labeling is to assist consumers in selecting foods to build a healthful diet.<sup>1</sup> The purpose of a front-of-package system, especially a fact-based one, is to help consumers quickly and easily compare products while shopping. The versions of the front-of-package system with more information, for example, version 3 and 4, tested in this study, generally enabled grocery shoppers to demonstrate improved comprehension of nutrient content of food products tested. These more robust versions also increased ease of understanding nutrition information and assisted with interpreting nutrition information on the products included in the study.

### Reported Food Label Behaviors

More than 80% of the 7,363 participants reported reading the Nutrition Facts label when purchasing a product for the first time. Although this percentage is comparable with FDA

**Table 5.** Interpretation of key evaluation measures for four versions of the front-of-package system for four food categories by primary household grocery shoppers to an interactive online survey (n=7,363)<sup>ab</sup>

Key evaluation measures	Percentage of Total Sample Who Strongly Agree or Agree <sup>c</sup>			
	Version 1: None (n=1,832)	Version 2: Calories only (n=1,850)	Version 3: Calories + nutrients to limit <sup>d</sup> (n=1,830)	Version 4: Calories + nutrients to limit <sup>d</sup> + nutrients to encourage <sup>e</sup> (n=1,851)
<b>Breakfast cereals</b>				
The nutrition information on the front of the package				
Helps me to understand different nutritional values	NA <sup>f</sup>	53	83 <sup>x</sup>	87 <sup>xy</sup>
Helps me make an informed decision	NA	60	84 <sup>x</sup>	89 <sup>xy</sup>
Is easy to understand	NA	79	89 <sup>x</sup>	90 <sup>x</sup>
Should be included on other food products	NA	67	83 <sup>x</sup>	85 <sup>x</sup>
Takes more time to understand than I am willing to spend	NA	26 <sup>y</sup>	21	24
Does not include enough important information	NA	64 <sup>yz</sup>	39 <sup>z</sup>	28
Is believable and trustworthy	NA	65	77 <sup>x</sup>	78 <sup>x</sup>
Is accurate	NA	65	74 <sup>x</sup>	72 <sup>x</sup>
<b>Frozen entrées</b>				
The nutrition information on the front of the package				
Helps me to understand different nutritional values	NA	54	84 <sup>x</sup>	89 <sup>xy</sup>
Helps me make an informed decision	NA	63	87 <sup>x</sup>	90 <sup>x</sup>
Is easy to understand	NA	79	89 <sup>x</sup>	90 <sup>x</sup>
Should be included on other food products	NA	69	85 <sup>x</sup>	87 <sup>x</sup>
Takes more time to understand than I am willing to spend	NA	24	22	25
Does not include enough important information	NA	63 <sup>yz</sup>	36 <sup>z</sup>	27
Is believable and trustworthy	NA	66	79 <sup>x</sup>	76 <sup>x</sup>
Is accurate	NA	65	73 <sup>x</sup>	71 <sup>x</sup>
<b>Salad dressings</b>				
The nutrition information on the front of the package				
Helps me to understand different nutritional values	NA	51	87 <sup>x</sup>	89 <sup>x</sup>
Helps me make an informed decision	NA	60	88 <sup>x</sup>	89 <sup>x</sup>
Is easy to understand	NA	81	91 <sup>x</sup>	91 <sup>x</sup>
Should be included on other food products	NA	67	84 <sup>x</sup>	85 <sup>x</sup>
Takes more time to understand than I am willing to spend	NA	20	20	22

(continued on next page)



**Table 5.** Interpretation of key evaluation measures for four versions of the front-of-package system for four food categories by primary household grocery shoppers to an interactive online survey (n=7,363)<sup>ab</sup> (continued)

Key evaluation measures	Percentage of Total Sample Who Strongly Agree or Agree <sup>c</sup>			
	Version 1: None (n = 1,832)	Version 2: Calories only (n = 1,850)	Version 3: Calories + nutrients to limit <sup>d</sup> (n = 1,830)	Version 4: Calories + nutrients to limit <sup>d</sup> + nutrients to encourage <sup>e</sup> (n = 1,851)
Does not include enough important information	NA	63 <sup>yz</sup>	30	30
Is believable and trustworthy	NA	67	79 <sup>x</sup>	81 <sup>x</sup>
Is accurate	NA	66	73 <sup>x</sup>	76 <sup>x</sup>
<b>Savory snacks</b>				
The nutrition information on the front of the package				
Helps me to understand different nutritional values	NA	50	87 <sup>x</sup>	89 <sup>x</sup>
Helps me make an informed decision	NA	57	87 <sup>x</sup>	88 <sup>x</sup>
Is easy to understand	NA	78	92 <sup>x</sup>	92 <sup>x</sup>
Should be included on other food products	NA	67	85 <sup>x</sup>	85 <sup>x</sup>
Takes more time to understand than I am willing to spend	NA	22	19	22
Does not include enough important information	NA	64 <sup>yz</sup>	32	31
Is believable and trustworthy	NA	65	77 <sup>x</sup>	81 <sup>xy</sup>
Is accurate	NA	65	72 <sup>x</sup>	75 <sup>x</sup>

<sup>a</sup>Survey respondents (n=7,363) were randomized to view and answer questions about six products within two of four product categories (breakfast cereals and frozen entrées or salad dressings and savory snacks) that specifically displayed only one of the four available front-of-package versions.

<sup>b</sup>Front-of-package versions varied in amount and type of information: version 1 contained no front-of-package information and version 4 contained the most front-of-package information.

<sup>c</sup>The question was stated as follows: "Looking at the nutrition information provided on the front of [these] products, please use the scale below to describe how much you agree or disagree with the following statements. Strongly agree, agree somewhat, neither agree nor disagree, disagree somewhat, strongly disagree." (See product statements under each category.)

<sup>d</sup>Nutrients to limit: saturated fat, sodium, and total sugars.

<sup>e</sup>Nutrients to encourage: vitamin A, fiber, and folate for breakfast cereals; protein, vitamin A, and iron for frozen entrées; vitamin A, vitamin C, or calcium for salad dressings; and vitamin C or iron for savory snacks.

<sup>f</sup>NA=not applicable.

<sup>x</sup>Significantly different from version 2 at P<0.05. Comparisons are made horizontally.

<sup>y</sup>Significantly different from version 3 at P<0.05. Comparisons are made horizontally.

<sup>z</sup>Significantly different from version 4 at P<0.05. Comparisons are made horizontally.

findings<sup>5</sup> for this behavior, other surveys about shoppers' label-reading habits report that approximately 65% read labels in the store.<sup>7,32</sup>

### Increasing Shoppers' Comprehension

In general, increasing the amount of nutrition information on the front of package improved accuracy and lessened the need to use the Nutrition Facts label. Consumers obtained the information they needed from the front-of-package label and therefore did not need to take time studying the Nutrition Facts label. Notably, the

increased comprehension was seen for those at the lower educational levels. This finding is especially important because these consumers usually have a lower comprehension of the Nutrition Facts label.<sup>33</sup> This front-of-package labeling system, especially version 4, assisted them in making more accurate assessments about the nutrient content of the food.

In general, consumers who were presented with the most front-of-package information on breakfast cereal and frozen entrée packaging had higher accuracy scores. However, consumers were occasionally just as

accurate in understanding nutrient information when provided fewer or no front-of-package details for salad dressings and savory snacks. This result may be because the Nutrition Facts labels for salad dressings and savory snacks were much less complicated—that is, listed fewer nutrients—compared with breakfast cereals and frozen entrées (Table 2, available online at [www.andjrn.org](http://www.andjrn.org)). The front-of-package labeling system was most helpful when a significant amount of information was in the Nutrition Facts label. The front-of-package system also resulted in more accurate assessments of nutrition quality if nutrients to

**Table 6.** Successful identification of absolute amounts and percent daily values of nutrients on four versions of front-of-package information for four product categories by primary household grocery shoppers who responded to an interactive online survey reported by consumer education level (n=7,363)<sup>ab</sup>

Key evaluation measures	Number of Questions (n=9) Answered Correctly <sup>c</sup>			
	Version 1: None (n=1,832)	Version 2: Calories only (n=1,850)	Version 3: Calories + nutrients to limit <sup>d</sup> (n=1,830)	Version 4: Calories + nutrients to limit <sup>d</sup> + nutrients to encourage <sup>e</sup> (n=1,851)
	←————— <i>mean ± standard deviation</i> —————→			
<b>Breakfast cereals</b>				
Some high school or less	7.36±2.16	7.56±1.91	7.62±1.70	8.45±1.29 <sup>yz</sup>
High school graduate	7.99±1.61	7.94±1.73	8.11±1.30	8.71±0.73 <sup>xyz</sup>
Some college	8.04±1.59	8.13±1.42	8.32±1.17 <sup>x</sup>	8.72±0.89 <sup>xyz</sup>
College graduate	8.21±1.32	8.00±1.61	8.24±1.27 <sup>y</sup>	8.61±1.02 <sup>xyz</sup>
<b>Frozen entrées</b>				
Some high school or less	7.35±2.77	7.71±2.28	7.69±2.23	8.44±1.75 <sup>xyz</sup>
High school graduate	7.92±2.19	7.80±2.36	8.15±1.48 <sup>y</sup>	8.77±0.96 <sup>xyz</sup>
Some college	8.07±2.20	8.10±1.92	8.33±1.42	8.81±0.93 <sup>xyz</sup>
College graduate	8.27±1.86	8.00±2.23	8.41±1.25 <sup>y</sup>	8.76±0.95 <sup>xyz</sup>
<b>Salad dressings</b>				
Some high school or less	8.22±1.85	8.39±1.42	8.44±1.15	8.68±0.82 <sup>xy</sup>
High school graduate	8.67±1.01	8.70±0.84	8.71±0.77	8.69±0.80
Some college	8.70±0.94	8.70±0.99	8.68±0.99	8.72±0.95
College graduate	8.76±0.90	8.67±0.96	8.71±0.90	8.78±0.76
<b>Savory snacks</b>				
Some high school or less	8.06±1.77	8.07±1.80	8.34±1.34	8.52±1.04 <sup>xy</sup>
High school graduate	8.49±1.15	8.47±1.19	8.48±1.24	8.45±1.30
Some college	8.50±1.21	8.54±1.04	8.48±1.23	8.60±1.06
College graduate	8.56±1.16	8.55±1.25	8.56±1.06	8.68±0.81

<sup>a</sup>Survey respondents (n=7,363) were randomized to view and answer questions about six products within two of four product categories (breakfast cereals and frozen entrées or salad dressings and savory snacks) that specifically displayed only one of the four available front-of-package versions.

<sup>b</sup>Front-of-package versions varied in amount and type of information: version 1 contained no front-of-package information and version 4 contained the most front-of-package information.

<sup>c</sup>Nine questions assessed primary grocery shoppers' comprehension of front-of-package information: Five questions involved identification of absolute numbers and four involved identifying percent daily values on front of package.

<sup>d</sup>Nutrients to limit: saturated fat, sodium, and total sugars.

<sup>e</sup>Nutrients to encourage: fiber, vitamin A and folate for breakfast cereals; protein, vitamin A, and iron A for frozen entrées; vitamin A, vitamin C, or calcium for salad dressings; and vitamin C or iron for savory snacks.

<sup>x</sup>Significantly different from version 1 at P<0.05. Comparisons are made horizontally.

<sup>y</sup>Significantly different from version 2 at P<0.05. Comparisons are made horizontally.

<sup>z</sup>Significantly different from version 3 at P<0.05. Comparisons are made horizontally.

encourage are included (version 4), which was also found by Roberto and colleagues.<sup>34</sup>

Notably, scores for identifying % DV for nutrients to encourage were significantly lower among respondents assigned to version 3 compared with versions 1, 2, or 4 in almost all product categories. When asked to identify information about nutrients not displayed on the front of package, those viewing versions 1 or 2 largely turned to the

Nutrition Facts label for information. However, those viewing version 3, which included calories and nutrients to limit, were less likely to find information about nutrients to encourage. This finding is concerning because encouraging nutrients and, therefore, foods needed to build a healthful diet, is critical to long-term health.

The US Dietary Guidelines encourage nutrient-dense/-rich foods and identify which to limit.<sup>27,35</sup> A front-of-package

labeling system on the product package should assist in communicating this information and more fully represent the nutrient contribution—not just nutrients to limit—of a food or beverage product. Nutrient-dense foods and beverages help consumers achieve healthful diets without over-consuming energy.<sup>36</sup>

A disproportionate focus on nutrients to limit may lead consumers to restrict healthful foods, such as tree

nuts and avocado-based products, which are high in fat but provide significant amounts of nutrients to encourage. A recent survey showed that although 33% of consumers are limiting calories, sugar, fat, and salt, they are also looking for healthier versions of foods they eat every day.<sup>6</sup> Consumers are trying to make more of their calories count for better overall health.<sup>6</sup> Therefore, it is important to include nutrients to encourage and limit on the front of package.

### Increasing Ease of Understanding and Interpretation Ratings

Consumers agreed that more nutrition information on the front of package assisted them in comprehension and that such information should appear on more products. Other studies have shown that more information is usually preferred.<sup>37</sup> In this study, presentation of the front of package with nutrients to encourage and limit and including some nutrients in both absolute numbers and %DV likely satisfied consumers' needs.

Among consumers who evaluated front-of-package versions 2, 3, or 4, there was greater agreement that the nutrition information aided in decision making and understanding than when given just the number of calories.

The ideal front-of-package system should be transparent and science based.<sup>36</sup> The system tested is consistent in appearance with the Nutrition Facts label, which consumers consider trustworthy,<sup>38</sup> is fact based and not interpretive, complies with the Code of Federal Regulations,<sup>4</sup> and has received enforcement discretion from the FDA for general use on the front of package<sup>39</sup> (Figures 1 and 2). With this type of system, at-a-glance product comparisons can occur on the shelf. Such easy access to this information can be crucial to increasing consumer use of nutrition information on product packaging, especially for those with a lower education level. Interpretation of information for any front-of-package system will depend on consumer understanding and education.

### Study Limitations

This study examined only one front-of-package system and did not compare it with other systems. The

survey was cross sectional and measured consumers' reactions at one point in time. Many factors beyond nutrition information that affect food purchase and consumption decisions, such as cost and brand, were not assessed as part of the study design. Results may vary for other food categories.

### IMPLICATIONS FOR PRACTICE AND RESEARCH

If a front-of-package labeling system is widely available, dietetics practitioners can use front-of-package information to provide clients a shortcut in making purchase decisions to build a healthful diet. When instructing clients with a high school education or less, front-of-package information is especially useful in improving understanding of nutrient information. Clients with higher education levels are likely to be able to accurately assess a product's nutritional value with or without additional front-of-package information. However, having front-of-package information on food and beverage products facilitates product comparisons.

Well-designed and tested front-of-package labeling has the potential to positively affect the health of Americans. Any front-of-package system should be tested at baseline and then monitored and evaluated over time for impact on awareness, comprehension/understanding, purchase decisions, usage/incorporation into consumers' everyday lives, and, ultimately, effect on health. Consumer response to this front-of-package system, which is the basis for the Facts Up Front program, should be monitored and evaluated to assess its impact. This front-of-package system provides concise, factual information in a format that consumers can understand and incorporate into their everyday lives.

Any system should be accompanied by a consumer education campaign promoted by health professional organizations, consumer groups, government agencies, commodity groups, and the food industry in order to effectively disseminate consistent messages and encourage informed food choices for an overall healthful diet.

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## AUTHOR INFORMATION

### STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

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**Table 1.** Demographic, socioeconomic, health, and food label usage characteristics of household primary grocery shoppers who responded to an interactive online survey reported by total sample and by version of the front-of-package system viewed (n=7,363)<sup>a</sup>

Characteristics	Total (n = 7,363)	Version 1: None (n = 1,832)	Version 2: Calories only (n = 1,850)	Version 3: Calories + nutrients to limit <sup>b</sup> (n = 1,830)	Version 4: Calories + nutrients to limit <sup>b</sup> and nutrients to encourage <sup>c</sup> (n = 1,851)
	← mean ± standard deviation →				
Age (y)	41.55 ± 13.98	41.58 ± 14.02	41.46 ± 13.97	41.49 ± 14.00	41.68 ± 3.95
Body mass index	26.70 ± 5.04	26.60 ± 5.04	26.60 ± 5.06	26.75 ± 5.01	26.85 ± 5.04
Self-reported health status <sup>d</sup>	3.00 ± 0.73	2.99 ± 0.73	3.00 ± 0.73	3.01 ± 0.72	3.00 ± 0.73
Household income (\$)	52,353 ± 28,122	52,234 ± 28,052	52,920 ± 28,121	51,832 ± 28,179	52,419 ± 28,149
No. of people living in household	2.97 ± 1.48	2.96 ± 1.52	2.94 ± 1.42	2.95 ± 1.48	3.01 ± 1.50
	← n (%) →				
<b>Sex</b>					
Female	4,963 (67)	1,236 (67)	1,246 (67)	1,237 (68)	1,244 (67)
Male	2,400 (33)	596 (33)	604 (33)	593 (32)	607 (33)
<b>Marital status</b>					
Married	3,851 (52)	932 (51)	968 (52)	947 (52)	1,004 (54) <sup>w</sup>
Living with someone	949 (13)	235 (13)	245 (13)	243 (13)	226 (12)
Single	1,515 (21)	389 (21)	367 (20)	380 (21)	379 (20)
Divorced/separated/ widowed	1,027 (14)	269 (15)	265 (14)	255 (14)	238 (13)
Other/refused to answer	21 (<1)	7 (<1)	5 (<1)	5 (<1)	4 (<1)
<b>Ethnicity</b>					
White	6,048 (82)	1,493 (81)	1,552 (82)	1,504 (82)	1,529 (83)
African American	582 (8)	152 (8)	148 (8)	141 (8)	141 (8)
Asian	282 (4)	68 (4)	79 (4)	69 (4)	66 (4)
Other	451 (6)	119 (6)	101 (5)	116 (6)	115 (6)
Hispanic origin (can be any race)	827 (11)	214 (12)	204 (11)	213 (12)	196 (11)
<b>Education</b>					
High school or less	2,702 (37)	667 (36)	680 (37)	660 (36)	695 (38)
Some college	2,406 (33)	603 (33)	604 (33)	604 (33)	595 (32)
College graduate	1,501 (20)	375 (20)	376 (20)	373 (20)	377 (20)
Postgraduate	754 (10)	187 (10)	190 (10)	193 (11)	184 (10)
<b>Employment status</b>					
Working full time	3,095 (42)	770 (42)	789 (43)	777 (42)	759 (41)
Working part time	938 (13)	236 (13)	221 (12)	227 (12)	254 (14)
Full-time student	324 (4)	85 (5)	84 (5)	76 (4)	79 (4)
Full-time homemaker	1,100 (15)	266 (15)	284 (15)	268 (15)	282 (15)
Retired	790 (11)	205 (11)	181 (10)	194 (11)	210 (11)
Unemployed	1,116 (15)	270 (15)	291 (16)	288 (16)	267 (14)

(continued on next page)

**Table 1.** Demographic, socioeconomic, health, and food label usage characteristics of household primary grocery shoppers who responded to an interactive online survey reported by total sample and by version of the front-of-package system viewed (n=7,363)<sup>a</sup> (continued)

Characteristics	Total (n=7,363)	Version 1: None (n=1,832)	Version 2: Calories only (n=1,850)	Version 3: Calories + nutrients to limit <sup>b</sup> (n=1,830)	Version 4: Calories + nutrients to limit <sup>b</sup> and nutrients to encourage <sup>c</sup> (n=1,851)
<b>Health problems of concern</b>	← n (%) →				
Obesity/overweight	3,034 (35)	739 (40)	781 (42)	728 (40)	786 (42) <sup>y</sup>
High cholesterol	2,591 (35)	660 (36)	641 (35)	622 (34)	668 (36)
Hypertension/high blood pressure	2,570 (35)	649 (35) <sup>x</sup>	591 (32)	641 (35) <sup>x</sup>	689 (37) <sup>x</sup>
Diabetes	1,590 (22)	399 (22)	380 (21)	396 (22)	415 (22)
Heart disease	1,167 (16)	301 (16)	285 (15)	275 (15)	306 (17)
Osteoporosis	1,066 (14)	264 (14)	263 (14)	256 (14)	283 (15)
Cancer	847 (12)	215 (12)	204 (11)	208 (11)	220 (12)
Stroke	654 (9)	180 (10) <sup>x</sup>	148 (8)	167 (9)	159 (9)
Not reported	2,595 (35)	615 (34)	666 (36)	684 (37) <sup>wz</sup>	630 (34)
<b>Children in household (0 to 17 y)</b>	4,615 (63)	1,116 (61)	1,153 (62)	1,121 (61)	1,225 (66)
<b>Portion of household's grocery shopping performed personally by respondent</b>					
All	5,200 (71)	1,325 (72) <sup>x</sup>	1,277 (69)	1,299 (71)	1,299 (70)
Half or more	2,163 (29)	507 (28)	573 (31) <sup>w</sup>	531 (29)	552 (30)
<b>Self-reported frequency of reading food labels when buying products for first time</b>					
Regularly	4,369 (59)	1,034 (56)	1,079 (58)	1,128 (62) <sup>wx</sup>	1,128 (61) <sup>w</sup>
Occasionally	2,003 (27)	498 (27)	513 (28)	488 (27)	504 (27)
Rarely	727 (10)	220 (12) <sup>xy</sup>	185 (10)	163 (9)	159 (9)
Never	264 (4)	80 (4) <sup>y</sup>	73 (4)	51 (3)	60 (3)
<b>Self-reported frequency of reading food labels to compare nutritional values when shopping</b>					
Regularly	3,668 (50)	848 (46)	906 (49)	961 (53) <sup>wx</sup>	953 (51) <sup>w</sup>
Occasionally	2,585 (35)	656 (36)	645 (35)	639 (35)	645 (35)
Rarely	858 (12)	248 (14) <sup>yz</sup>	237 (13) <sup>yz</sup>	176 (10)	197 (11)
Never	252 (3)	80 (4) <sup>yz</sup>	62 (3)	54 (3)	56 (3)

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**Table 1.** Demographic, socioeconomic, health, and food label usage characteristics of household primary grocery shoppers who responded to an interactive online survey reported by total sample and by version of the front-of-package system viewed (n=7,363)<sup>a</sup> (continued)

Characteristics	Total (n = 7,363)	Version 1: None (n = 1,832)	Version 2: Calories only (n = 1,850)	Version 3: Calories + nutrients to limit <sup>b</sup> (n = 1,830)	Version 4: Calories + nutrients to limit <sup>b</sup> and nutrients to encourage <sup>c</sup> (n = 1,851)
	←————— n (%) —————→				
<b>Self-reported frequency of reading food labels when buying food products regularly</b>					
Regularly	2,663 (36)	599 (33)	671 (36) <sup>w</sup>	697 (38) <sup>w</sup>	696 (38) <sup>w</sup>
Occasionally	2,958 (40)	742 (41)	719 (39)	753 (41)	744 (40)
Rarely	1,424 (19)	405 (22) <sup>yz</sup>	371 (20) <sup>y</sup>	317 (17)	331 (18)
Never	318 (4)	86 (5)	89 (5) <sup>y</sup>	63 (3)	80 (4)

<sup>a</sup>Survey respondents (n=7,363) were randomized to one of the four available front-of-package versions. The versions varied in amount and type of information: version 1 contained no front-of-package information and version 4 contained the most front-of-package information.

<sup>b</sup>Nutrients to limit: saturated fat, sodium, and total sugars.

<sup>c</sup>Nutrients to encourage: fiber, vitamin A, and folate for breakfast cereals; protein, vitamin A, and iron for frozen entrées; vitamin A, vitamin C, or calcium for salad dressings; and vitamin C or iron for savory snacks.

<sup>d</sup>Health perceived as excellent (4), good (3), fair (2), poor (1).

<sup>w</sup>Significantly different from version 1 at P<0.05. Comparisons are made horizontally.

<sup>x</sup>Significantly different from version 2 at P<0.05. Comparisons are made horizontally.

<sup>y</sup>Significantly different from version 3 at P<0.05. Comparisons are made horizontally.

<sup>z</sup>Significantly different from version 4 at P<0.05. Comparisons are made horizontally.

**Table 2.** Comprehension and identification of absolute amounts and percent daily values of nutrient measurements for four food categories by primary household grocery shoppers who responded to an interactive online survey reported by version of the front-of-package system (n=7,363)<sup>ab</sup>

Key evaluation measures <sup>c</sup>	Percentage of Correct Answers for Total Sample			
	Version 1: None (n = 1,832)	Version 2: Calories only (n = 1,850)	Version 3: Calories + nutrients to limit <sup>d</sup> (n = 1,830)	Version 4: Calories + nutrients to limit <sup>d</sup> + nutrients to encourage <sup>e</sup> (n = 1,851)
<b>Breakfast cereals</b>				
Absolute number identification				
Calories	91	95 <sup>w</sup>	96 <sup>w</sup>	98 <sup>wxy</sup>
Sodium (mg)	84	84	92 <sup>wx</sup>	94 <sup>wx</sup>
Saturated fat (g)	88	87	95 <sup>wx</sup>	97 <sup>wxy</sup>
Sugars (g)	93 <sup>x</sup>	90	95 <sup>wx</sup>	97 <sup>wxy</sup>
Fiber (g)	80	83	87 <sup>wx</sup>	93 <sup>wxy</sup>
Total	87	88	94	96
%DV <sup>f</sup> identification				
Sodium	90	88	94 <sup>wx</sup>	96 <sup>wxy</sup>
Saturated fat	89	86	93 <sup>wx</sup>	98 <sup>wxy</sup>
Fiber	84 <sup>y</sup>	81 <sup>y</sup>	72	92 <sup>wxy</sup>
Folate	91 <sup>y</sup>	90 <sup>y</sup>	83	97 <sup>wxy</sup>
Total	88	86	86	96
<b>Frozen entrées</b>				
Absolute number identification				
Calories	89	96 <sup>w</sup>	97 <sup>w</sup>	98 <sup>wx</sup>
Sodium (mg)	87	85	96 <sup>wx</sup>	97 <sup>wx</sup>
Saturated fat (g)	87 <sup>x</sup>	83	96 <sup>wx</sup>	97 <sup>wx</sup>
Sugars (g)	90	88	97 <sup>wx</sup>	98 <sup>wx</sup>
Protein (g)	87 <sup>z</sup>	87 <sup>z</sup>	78	98 <sup>wxy</sup>
Total	88	87	93	97
%DV identification				
Sodium	90	89	95 <sup>wx</sup>	97 <sup>wxy</sup>
Saturated fat	86	85	92 <sup>wx</sup>	94 <sup>wx</sup>
Vitamin A	92 <sup>y</sup>	91 <sup>y</sup>	87	97 <sup>wxy</sup>
Iron	90 <sup>y</sup>	88 <sup>y</sup>	83	97 <sup>wxy</sup>
Total	90	88	89	96
<b>Salad dressings</b>				
Absolute number identification				
Calories	95	97 <sup>w</sup>	98 <sup>w</sup>	98 <sup>w</sup>
Sodium (mg)	96	94	97 <sup>x</sup>	97 <sup>x</sup>
Sugars (g)	97	96	98 <sup>x</sup>	98 <sup>wx</sup>
Cholesterol (mg)	97 <sup>yz</sup>	96 <sup>yz</sup>	89	88
Saturated fat (g)	92	91	96 <sup>wx</sup>	97 <sup>wx</sup>
Total	96	95	95	96

(continued on next page)



**Table 2.** Comprehension and identification of absolute amounts and percent daily values of nutrient measurements for four food categories by primary household grocery shoppers who responded to an interactive online survey reported by version of the front-of-package system (n=7,363)<sup>ab</sup> (continued)

Key evaluation measures <sup>c</sup>	Percentage of Correct Answers for Total Sample			
	Version 1: None (n = 1,832)	Version 2: Calories only (n = 1,850)	Version 3: Calories + nutrients to limit <sup>d</sup> (n = 1,830)	Version 4: Calories + nutrients to limit <sup>d</sup> + nutrients to encourage <sup>e</sup> (n = 1,851)
<b>%DV identification</b>				
Vitamin A	97 <sup>yz</sup>	97 <sup>yz</sup>	93	93
Vitamin C	96 <sup>yz</sup>	98 <sup>wyz</sup>	93	93
Sodium	93	94	95	97 <sup>wx</sup>
Calcium	97 <sup>yz</sup>	96 <sup>yz</sup>	91	91
Total	96	96	93	94
<b>Savory snacks</b>				
<b>Absolute number identification</b>				
Calories	96	98 <sup>w</sup>	98 <sup>w</sup>	98 <sup>w</sup>
Sodium (mg)	92	93	97 <sup>wx</sup>	97 <sup>wx</sup>
Saturated fat (g)	90	89	97 <sup>wx</sup>	96 <sup>wx</sup>
Sugars (g)	97	97	98 <sup>wx</sup>	98 <sup>wx</sup>
Protein (g)	96 <sup>yz</sup>	95 <sup>yz</sup>	88	88
Total	94	94	95	95
<b>%DV identification</b>				
Sodium (DV%)	93	93	96 <sup>w</sup>	96 <sup>wx</sup>
Saturated fat (DV%)	88	88	91 <sup>wx</sup>	93 <sup>wx</sup>
Vitamin C (DV%)	96 <sup>yz</sup>	95 <sup>yz</sup>	92	92
Iron (DV%)	95 <sup>y</sup>	94 <sup>y</sup>	90	95 <sup>y</sup>
Total	93	92	92	94

<sup>a</sup>Survey respondents (n=7,363) were randomized to view and answer questions about six products within two of four product categories (breakfast cereals and frozen entrées or salad dressings and savory snacks) that specifically displayed only one of the four available front-of-package versions.

<sup>b</sup>Front-of-package versions varied in amount and type of information: version 1 contained no front-of-package information and version 4 contained the most front-of-package information.

<sup>c</sup>The number of Nutrition Facts label nutrients and percent of Daily Value listings per product category: breakfast cereals, 57; frozen entrées, 27; salad dressings, 21; savory snacks, 21.

<sup>d</sup>Nutrients to limit: saturated fat, sodium, and total sugars.

<sup>e</sup>Nutrients to encourage: fiber, vitamin A, and folate for breakfast cereals; protein, vitamin A, and iron for frozen entrées; vitamin A, vitamin C, or calcium for salad dressings; and vitamin C or iron for savory snacks.

<sup>f</sup>%DV=percent daily value.

<sup>w</sup>Significantly different from version 1 at  $P < 0.05$ . Comparisons are made horizontally.

<sup>x</sup>Significantly different from version 2 at  $P < 0.05$ . Comparisons are made horizontally.

<sup>y</sup>Significantly different from version 3 at  $P < 0.05$ . Comparisons are made horizontally.

<sup>z</sup>Significantly different from version 4 at  $P < 0.05$ . Comparisons are made horizontally.

**Table 3.** Identification of products with the lowest or highest nutritional value and best perceived nutritional value for four food product categories performed by primary household grocery shopper respondents to an interactive online survey reported by version of the front-of-package system (n=7,363)<sup>ab</sup>

Nutrient questions	Percentage of Responses of Individuals by Front-of-Package Version			
	Version 1: None (n=1,832)	Version 2: Calories only (n=1,850)	Version 3: Calories + nutrients to limit <sup>c</sup> (n=1,830)	Version 4: Calories + nutrients to limit <sup>c</sup> + nutrients to encourage <sup>d</sup> (n=1,851)
<b>Breakfast cereals</b>				
Which of these three breakfast cereal products contains the lowest number of calories per serving?				
Product 1 <sup>e</sup>	90	93 <sup>w</sup>	93	95 <sup>w</sup>
Product 2	3	4	3	3
Product 3	3 <sup>xz</sup>	1	2	2
Don't know/not sure	4 <sup>xz</sup>	2	3 <sup>z</sup>	1
Which of these three breakfast cereal products contains the lowest amount of sodium per serving?				
Product 1	9	12 <sup>wyz</sup>	7	8
Product 2	84 <sup>x</sup>	79	88 <sup>wx</sup>	88 <sup>wx</sup>
Product 3	3	2	2	2
Don't know/not sure	4 <sup>z</sup>	6 <sup>wyz</sup>	3	2
Now looking at all three of these breakfast cereal products, please select which product you believe is the best choice with respect to nutritional value.				
Product 1	70	71 <sup>y</sup>	67	73 <sup>y</sup>
Product 2	13	12	17 <sup>wxz</sup>	12
Product 3	3	3	2	2
None	8	7	8	9
Don't know/not sure	6 <sup>z</sup>	6 <sup>z</sup>	7 <sup>z</sup>	3
<b>Frozen entrées</b>				
Which frozen entrée product contains the lowest number of calories per serving?				
Product 1	89	92	94 <sup>w</sup>	94 <sup>wx</sup>
Product 2	2	4 <sup>w</sup>	3	3
Product 3	4 <sup>yz</sup>	2	2	2
Don't know/not sure	4 <sup>xyz</sup>	2	1	1
Which frozen entrée product contains the highest amount of sodium per serving?				
Product 1	29 <sup>yz</sup>	29 <sup>yz</sup>	22	22
Product 2	4 <sup>y</sup>	3	2	3
Product 3	63	63	74 <sup>wx</sup>	74 <sup>wx</sup>
Don't know/not sure	4 <sup>yz</sup>	5 <sup>yz</sup>	1	1

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**Table 3.** Identification of products with the lowest or highest nutritional value and best perceived nutritional value for four food product categories performed by primary household grocery shopper respondents to an interactive online survey reported by version of the front-of-package system (n=7,363)<sup>ab</sup> (continued)

Nutrient questions	Percentage of Responses of Individuals by Front-of-Package Version			
	Version 1: None (n=1,832)	Version 2: Calories only (n=1,850)	Version 3: Calories + nutrients to limit <sup>c</sup> (n=1,830)	Version 4: Calories + nutrients to limit <sup>c</sup> + nutrients to encourage <sup>d</sup> (n=1,851)
Now looking at all three of these frozen entrée products, please select which product you believe is the best choice with respect to nutritional value.				
Product 1	75	78	81 <sup>wz</sup>	76
Product 2	9 <sup>y</sup>	7	6	10 <sup>y</sup>
Product 3	3	3	3	3
None	7	7	6	7
Don't know/not sure	6	5	5	5
<b>Salad dressings</b>				
Which salad dressing product contains the lowest number of calories per serving?				
Product 1	94	96 <sup>w</sup>	96 <sup>w</sup>	96
Product 2	1	1	1	2
Product 3	3 <sup>yz</sup>	2	1	1
Don't know/not sure	2 <sup>xy</sup>	1	1	1
Which salad dressing product contains the lowest amount of sodium per serving?				
Product 1	30 <sup>yz</sup>	26 <sup>y</sup>	22	24
Product 2	3	2	2	2
Product 3	64	69 <sup>w</sup>	74 <sup>wx</sup>	73 <sup>w</sup>
Don't know/not sure	3 <sup>yz</sup>	2 <sup>z</sup>	1	1
Now looking at all three of these salad dressing products, please select which product you believe is the best choice with respect to nutritional value.				
Product 1	80	83	84 <sup>w</sup>	83
Product 2	3	3	2	3
Product 3	3	2	2	2
None	11 <sup>z</sup>	8	9	8
Don't know/not sure	4	4	3	4

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**Table 3.** Identification of products with the lowest or highest nutritional value and best perceived nutritional value for four food product categories performed by primary household grocery shopper respondents to an interactive online survey reported by version of the front-of-package system (n=7,363)<sup>ab</sup> (continued)

Nutrient questions	Percentage of Responses of Individuals by Front-of-Package Version			
	Version 1: None (n=1,832)	Version 2: Calories only (n=1,850)	Version 3: Calories + nutrients to limit <sup>c</sup> (n=1,830)	Version 4: Calories + nutrients to limit <sup>c</sup> + nutrients to encourage <sup>d</sup> (n=1,851)
<b>Savory snacks</b>				
Which savory snack product contains the lowest number of calories per serving?				
<u>Product 1</u>	89	90	94 <sup>wx</sup>	92 <sup>w</sup>
Product 2	2	2	1	2
Product 3	4	5	4	4
Don't know/not sure	4 <sup>yz</sup>	3 <sup>y</sup>	2	2
Which savory snack product contains the highest amount of sodium per serving?				
<u>Product 1</u>	89	90	94 <sup>wx</sup>	92
Product 2	3 <sup>y</sup>	3	2	3
Product 3	4 <sup>y</sup>	3	2	3
Don't know/not sure	3	4	2	3
Now looking at all three of these savory snack products, please select which product you believe is the best choice with respect to nutritional value.				
<u>Product 1</u>	86	85	88	87
Product 2	1	2	1	2
Product 3	4 <sup>yz</sup>	4 <sup>y</sup>	2	2
None	5	5	4	5
Don't know/not sure	4	4	3	3

<sup>a</sup>Survey respondents (n=7,363) were randomized to view and answer questions about six products within two of four product categories (breakfast cereals and frozen entrées or salad dressings and savory snacks) that specifically displayed only one of the four available front-of-package versions.

<sup>b</sup>Front-of-package versions varied in amount and type of information: version 1 contained no front-of-package information and version 4 contained the most front-of-package information. Those respondents assigned to versions 1 and 2 needed to refer to the Nutrition Facts label to answer all or some of these questions, respectively.

<sup>c</sup>Nutrients to limit: saturated fat, sodium, and total sugars.

<sup>d</sup>Nutrients to encourage: fiber, vitamin A, and folate for breakfast cereals; protein, vitamin A, and iron for frozen entrées; vitamin A, vitamin C, or calcium for salad dressings; and vitamin C or iron for savory snacks.

<sup>e</sup>Product number that carried the correct answer is underlined.

<sup>w</sup>Significantly different from version 1 at  $P < 0.05$ . Comparisons are made horizontally.

<sup>x</sup>Significantly different from version 2 at  $P < 0.05$ . Comparisons are made horizontally.

<sup>y</sup>Significantly different from version 3 at  $P < 0.05$ . Comparisons are made horizontally.

<sup>z</sup>Significantly different from version 4 at  $P < 0.05$ . Comparisons are made horizontally.