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Facts Up Front Versus Traffic Light Food Labels

A Randomized Controlled Trial

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Background: The U.S. food and beverage industry recently released a new front-of-package nutrition labeling system called Facts Up Front that will be used on thousands of food products.

Purpose: To test consumer understanding of the Facts Up Front system (Facts Up Front) compared to the Multiple Traffic Light system (Traffic Light). Facts Up Front displays grams/milligrams and percentage daily value information for various nutrients; Traffic Light uses an interpretive color-coded scheme to alert consumers to low, medium, and high levels of certain nutrients.

Design: Participants in an Internet-based study were randomized to one of five front-of-package label conditions: (1) no label; (2) Traffic Light; (3) Traffic Light plus information about protein and fiber (Traffic Light+); (4) Facts Up Front; or (5) Facts Up Front plus information about “nutrients to encourage” (Facts Up Front+).

Setting/participants: A total of 703 adults recruited through an online database in May 2011 participated in this study, and data were analyzed in June 2011.

Main outcome measures: Total percentage correct quiz scores were generated reflecting participants' ability to compare two foods on nutrient levels, based on their labels, and to estimate amounts of saturated fat, sugar, sodium, fiber and protein in the foods.

Results: The front-of-package label groups outperformed the control group on nearly all of the nutrient quizzes ($p < 0.05$). The control group did not differ from the Facts Up Front group on the saturated fat quiz, or from the Facts Up Front+ group on the sugars quiz. Those in the Traffic Light+ group had the best overall performance ($> 80\%$ on all quizzes).

Conclusions: Overall, those in the Traffic Light+ condition performed better than those in the Facts Up Front conditions on measures of nutrition knowledge and label perceptions.

Trial registration: This study is registered at clinicaltrials.gov NCT01626729. (Am J Prev Med 2012;43(2):134–141) © 2012 American Journal of Preventive Medicine

Background

In May 2010, the White House Childhood Obesity Task Force identified the need to improve front-of-package nutrition labels,¹ which are meant to display nutrition information in an easily understood format that consumers can view quickly when making purchasing decisions. A confusing array of such industry-initiated

labeling systems currently appear on packaged foods in the U.S.,² whereas other countries have proposed uniform labeling systems such as the Keyhole program in Sweden, the Choices program in the Netherlands, and the Multiple Traffic Light (Traffic Light) label developed by the United Kingdom Food Standards Agency. The Traffic Light approach uses red, green, and yellow circles to alert customers to levels of fat, saturated fat, sugar, and salt in foods³ and has a growing body of research supporting its use.^{4–6}

The Food and Drug Administration (FDA) has undertaken a front-of-package labeling initiative to promote a science-based, uniform system in the U.S.⁷ (Note that all references to food-package labeling in the current study relate to front-of-package labeling.) As part of this initia-

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tive, the IOM has prepared two reports on the topic.^{8,9} However, in advance of the IOM's final report, U.S. food and beverage manufacturers and retailers released a new labeling system called Facts Up Front.¹⁰ These labels include information about calories, saturated fat, sodium, sugars, and up to two (of a possible eight) "nutrients to encourage," such as fiber or vitamin A, that manufacturers can opt to include. The labeling system also will be accompanied by a \$50-million consumer education campaign.

Little publically available research has evaluated the utility of this industry system. Therefore, one aim of the current study was to compare Facts Up Front to a modified version of Traffic Light to determine which better promotes accurate understanding of nutritional profiles of packaged foods. A second aim was to examine whether information about "nutrients to encourage" is helpful when making nutrition judgments.

Methods

Participants

Participants were recruited through Survey Sampling International, an online panel of U.S. consumers that participate in surveys in exchange for points redeemable for products. The survey was administered in May 2011 (prior to the release of Facts Up Front) via Qualtrics, an online survey program, and data were analyzed in June 2011. Participants were recruited so that the educational profile of the sample was similar to that reported in 2010 U.S. Census data. Yale University's Human Subjects Committee approved the present study.

Label Conditions

After participants provided informed consent, they were randomized to one of five labeling conditions (displayed in Figure 1):

- No label (control)
- Traffic Light: a kilocalories (calories)-per-serving label and a modified Traffic Light symbol with text (High/Med/Low) indicating amounts of saturated fat, sugars, and sodium per serving. This symbol was based on the UK's Traffic Light, which appears on some foods.³
- Traffic Light plus information about "nutrients to encourage" (Traffic Light+): a calories-per-serving label and a modified Traffic Light symbol with text (High/Med/Low) indicating amounts of saturated fat, sugars, sodium, fiber, and protein per serving.
- Facts Up Front: a label displaying calories, saturated fat, sodium, and sugars per serving. Nutrient amounts were listed in grams/milligrams and percentage daily values (% DVs), which indicate whether a serving of food is high or low in a nutrient, based on daily value recommendations for a 2000-calorie diet, were included. This symbol was created based on the Facts Up Front symbol description provided by the Grocery Manufacturers Association (GMA) and Food Marketing Institute (FMI),¹⁰ without the inclusion of "nutrients to encourage."
- Facts Up Front plus information about "nutrients to encourage" (Facts Up Front+): a label displaying calories, saturated fat, sodium, and

Table 1. List of food and beverage products tested in an Internet-based front-of-package nutrition label study

Nutrient-level quiz
Beverages (which is higher in calories?)
Very Fine® Cranberry Cocktail ^a
V8® Vegetable Juice
Breads and grains (which is higher in sodium?)
Arnold's® Bread Soft Honey Wheat ^a
Nature's Own® 100% Whole Wheat
Cereals (which is higher in fiber?)
Kellogg's® Mini-Wheats Unfrosted Bite Size ^a
General Mills® Cheerios
Condiments and dressings (which is higher in sugar?)
Kraft® Classic Caesar
Kraft® Buttermilk Ranch Dressing ^a
Desserts (which is higher in sugar?)
Oreos® ^a
Mallomars®
Desserts (which is lower in protein?)
Haagen-Dazs® Vanilla and Almonds
Klondike® Vanilla Ice Cream Sandwiches ^a
Pasta mixes (which is higher in saturated fat?)
Knorr® Pasta Sides Stroganoff
Pasta Roni® Fettuccine Alfredo ^a
Snacks (which is higher in saturated fat?)
Baked Lays® Barbecue
Pringles® Sour Cream & Onion ^a
Snacks (which is lower in saturated fat?)
Snyder's of Hanover® Pretzels Honey Mustard & Onion
Rold Gold® Honey Mustard ^a
Individual products rated
Chips Ahoy® Chocolate Chip Cookies
Popsicles® Firecracker
Wheat Thins® Original
Campbell's® Chunky New England Clam Chowder
Nesquik® Chocolate Milk Reduced Fat, Regular
Pepperidge Farm® 9 Grain Bread
Quaker® Natural Granola Oats & Honey
Wish-Bone® House Italian Dressing

^aIndicates correct answer on quiz

sugars per serving. The label also showed two (of the possible eight) “nutrients to encourage” with the highest % DV. Nutrient amounts were listed in grams/milligrams and % DVs were included. This symbol was based directly on the Facts Up Front symbol description provided by the GMA and FMI.¹⁰

Both Traffic Light labels had colored circles, where red, yellow, and green represented high, medium, and low amounts of nutrients in the foods, respectively. These colors were reversed in the Traffic Light+ label for fiber and protein. The Traffic Light labels did not display grams/milligrams or % DV.

Nutrition Criteria

The foods and beverages included were U.S. brand name products selected from eight categories (Table 1 provides a product list). Nutrient information was obtained from manufacturer websites. The classification of nutrients as high, medium, or low was based on FDA guidelines,¹¹ which suggests 5% DV and 20% DV as approximate thresholds for medium and high nutrient content per serving, respectively. % DVs for saturated fat and sodium were calculated using FDA daily reference values based on a 2000-calorie diet.

The FDA does not suggest a daily reference value for sugars; therefore, recommendations from the American Heart Association specifying an upper limit of 32 g of added sugar per day were used.¹² Products were considered to have medium and high levels of added sugar if they contained more than 5% and 20%, respectively, of 32 g of added sugar. The added sugar content of the foods was estimated using a U.S. Department of Agriculture database.¹³

Survey Procedure

Participants first viewed a public service advertisement (PSA) modeled after an advertisement for a former labeling system created by food manufacturers in conjunction with scientists, nutrition educa-

Table 2. Sociodemographic information for front-of-package nutrition label Internet study sample^a

Characteristic	M (±SD) or n (column %)	df	Test statistic	p-value ^b
Age (years, M [SD])	46.01 (16.51)	4;670	1.14	0.338
Influence of labels ^c (M [SD])	6.31 (2.29)	4;672	1.80	0.127
BMI (M [SD])	29.62 (8.28)	4;646	0.418	0.796
Normal weight (<25)	196 (30.1)	4	1.78	0.777
Overweight/obese (≥25)	455 (69.9)	—	—	—
Gender				
Female	356 (52.6)	4	0.69	0.953
Male	321 (47.4)			
Race/ethnicity		20	21.04	0.395
Caucasian	558 (82.4)	—	—	—
African-American	55 (8.1)	—	—	—
Hispanic	24 (3.5)	—	—	—
Asian	26 (3.8)	—	—	—
American Indian	10 (1.5)	—	—	—
Other	4 (.6)	—	—	—
Educational level		16	12.89	0.681
<High school	39 (5.8)	—	—	—
High school	315 (46.9)	—	—	—
Associate’s degree/some college or trade school	133 (19.8)	—	—	—
Bachelor’s degree	128 (19.1)	—	—	—
Graduate/professional degree	56 (8.3)	—	—	—
Income (\$)				
<15,000	100 (14.8)	16	14.44	0.565
15,000–44,999	286 (42.4)	—	—	—
45,000–89,999	204 (30.3)	—	—	—
90,000–150,000	63 (9.3)	—	—	—
>150,000	21 (3.1)	—	—	—
Currently trying to lose weight				
Yes	366 (54.1)	4	6.00	0.199
No	311 (45.9)	—	—	—

^aTable values are M±SD for continuous variables and n (column %) for categoric variables. Percentages are calculated based on the total number of participants providing data for each individual variable.

^bTest statistics and p-values are for univariate ANOVAs (continuous variables) or χ^2 tests (categoric variables) comparing the five front-of-package label conditions.

^cMeasured on a 9-point Likert scale df, degrees of freedom

tors, and public health organizations, called the Smart Choices program.¹⁴ Each PSA had the words “Become Label Conscious” and described how to interpret the labeling system the participant was

Table 3. Nutrient-level percentage-correct quiz scores and product perceptions by front-of-package label condition, % unless otherwise noted

Outcome	No-label control (n=123)	Traffic Light (n=142)	Traffic Light+ (n=144)	Facts Up Front (n=151)	Facts Up Front+ (n=143)	F	p*	η ²
Nutrient-level quiz	39.5 (19.5)	83.5 (27.4) ^{a,b}	83.9 (25.7) ^{a,b}	91.7 (19.0) ^{a,c,d}	90.5 (19.2) ^a	119.33	<0.001	.048
Total with protein and fiber	41.6 (18.2)	71.1 (21.7) ^{a,b,d}	84.6 (24.4) ^{a,c}	78.9 (17.1) ^{a,c,e}	87.8 (18.6) ^{a,b,c}	108.72	<0.001	0.041
Saturated fat quiz	54.9 (17.8)	80.9 (14.0) ^{a,b,d,e}	95.2 (13.2) ^{a,b,c,e}	60.6 (18.8) ^{c,d}	63.9 (20.9) ^{a,c,d}	127.17	<0.001	0.039
Underestimated ^f	1.43 (1.32)	0.24 (0.80) ^{a,b,e}	0.15 (0.64) ^{a,b,e}	2.38 (1.74) ^{a,c,d}	1.98 (1.64) ^{a,c,d}	84.24	<0.001	0.039
Sugars quiz	45.7 (17.1)	75.4 (19.7) ^{a,b,d,e}	91.9 (17.7) ^{a,b,c,e}	52.1 (19.9) ^{a,c,d}	47.3 (20.0) ^{c,d}	156.37	<0.001	0.071
Underestimated ^f	3.45 (1.94)	1.91 (1.73) ^{a,b,d,e}	0.59 (1.48) ^{a,b,c,e}	4.08 (2.53) ^{a,c,d}	4.43 (2.45) ^{a,c,d}	83.94	<0.001	0.142
Sodium quiz	43.9 (15.8)	90.2 (20.0) ^{a,b,e}	94.1 (15.5) ^{a,b,e}	56.9 (22.9) ^{a,c,d}	59.1 (24.7) ^{a,c,d}	160.35	<0.001	0.068
Underestimated ^f	1.24 (1.13)	0.35 (0.89) ^a	0.23 (0.81) ^{a,e}	0.53 (0.97) ^a	0.56 (0.96) ^{a,d}	21.34	<0.001	0.084
Fiber quiz	55.9 (18.5)	56.2 (16.7) ^{d,e}	94.7 (15.2) ^{a,b,c,e}	60.2 (17.2) ^{d,e}	72.8 (20.5) ^{a,b,c,d}	119.56	<0.001	0.042
Overestimated ^f	3.48 (2.00)	3.14 (2.08) ^{d,e}	0.42 (1.34) ^{a,b,c,e}	2.64 (1.96) ^{a,d,e}	1.19 (1.93) ^{a,b,c,d}	66.50	<0.001	0.144
Protein quiz	59.0 (19.8)	60.9 (19.4) ^{d,e}	94.5 (14.7) ^{a,b,c,e}	63.8 (17.8) ^d	67.4 (17.1) ^{a,c,d}	91.68	<0.001	0.032
Overestimated ^f	3.02 (2.12)	2.38 (2.26) ^{d,e}	0.42 (1.21) ^{a,b,c,e}	2.01 (1.94) ^{a,d}	1.70 (1.96) ^{a,c,d}	33.47	<0.001	0.091
Calories per serving quiz	2.7 (5.7)	88.1 (28.1) ^a	89.9 (26.5) ^a	87.1 (31.1) ^a	90.0 (26.2) ^a	285.90	<0.001	0.152
Healthfulness ^g	5.5 (1.4)	5.2 (1.4)	4.9 (1.4)	5.1 (1.5)	5.3 (1.5)	2.91	0.021	0.001
Taste ^g	6.9 (1.5)	6.8 (1.7)	6.9 (1.5)	6.9 (1.6)	6.8 (1.6)	0.21	0.934	0.000
Intent to purchase ^g								
Self	5.2 (1.9)	5.2 (1.9)	5.1 (1.8)	5.2 (1.9)	5.3 (2.0)	0.19	0.943	0.000
Children ^h	7.3 (2.6)	6.2 (2.9)	6.5 (2.7)	6.4 (2.9)	6.5 (2.7)	0.78	0.541	0.002
Label preferences								
Easy to Interpret and understand ⁱ	3.9 (0.8)	3.7 (1.0) ^{d,e}	4.0 (1.0) ^{b,c,e}	3.6 (0.9) ^{d,e}	3.1 (0.7) ^{a,b,c,d}	19.28	<0.001	0.006
Too much information and time ⁱ	2.0 (1.1)	1.8 (1.0) ^e	1.8 (1.0) ^e	1.7 (0.8) ^{a,e}	2.8 (0.7) ^{a,b,c,d}	32.56	<0.001	0.032
Confusing ⁱ	1.9 (0.3)	1.9 (0.3)	1.9 (0.3)	1.9 (0.3)	8.4 (2.0) ^{a,b,c,d}	1303.52	<0.001	0.383

Note: Values are M (SD).

^aSignificantly different than No-Label Control, *p*<0.05

^bSignificantly different than Facts Up Front, *p*<0.05

^cSignificantly different than Traffic Light, *p*<0.05

^dSignificantly different than Traffic Light+, *p*<0.05

^eSignificantly different than Facts Up Front+, *p*<0.05

^fScores closer to 0 reflect a lower degree of over- or under-estimating nutrient levels.

^gMeasured on 10-point Likert Scale

^hThis question was answered only by those with children.

ⁱMeasured on a 5-point Likert scale

*Overall *F* test considered significant if <0.003 based on a Bonferroni-corrected alpha level

Traffic Light+, Traffic Light with positive nutrients (protein and fiber); Facts Up Front+, Facts Up Front plus information on “nutrients to encourage”

about to see. Individuals in the No-Label control condition saw a nearly identical PSA without label interpretation instructions. Those in the Facts Up Front groups were shown a PSA that also explained how to interpret % DV.

After viewing the PSA, participants took a nutrient-level comparison quiz asking them to identify which of two products presented side-by-side in the same food category was higher or lower in various nutrients. Both products had the same type of label reflecting the nutrition criteria for that product. The quiz included three questions about saturated fat, two questions about sugar, and one question each about sodium, calories, protein, and fiber.

After completing this nine-item nutrient-level comparison quiz, participants viewed eight different individual products and were asked to estimate whether the product had low, medium, or high amounts of saturated fat, sugar, sodium, fiber, and protein. In addition, participants were asked to provide an estimate of calories per serving and rate perceptions of health, taste, and purchase intent. During the survey, the front of each product was shown with the label on it, and an enlarged version of the label appeared adjacent to the product to ensure participants could see it. The Nutrition Facts Panel was not shown. All health claims such as “reduced fat” were removed from the product images.

Main Outcome Measures

Nutrient understanding and level-estimation accuracy.

Scores on the nutrient-level comparison quiz were the total percentage correct with and without the protein and fiber questions. For the saturated fat, sugar, sodium, fiber, and protein quizzes, correct answers were based on the FDA criteria, which was the basis for the “High/Med/Low” indicators on the Traffic Light labels. For the saturated fat, sodium, and sugar quizzes, answers for products that had either medium or high levels of these nutrients were recoded to reflect the degree of underestimation. For example, if a product was high in saturated fat, a participant would receive a 1 for indicating that the product had medium levels or a 2 for indicating it had low levels of saturated fat. These scores were averaged across the included products. In contrast, scores relating to products with low and medium levels of fiber and protein were examined to capture the degree of overestimation.

Participants provided an estimate of the calories per serving for the individual products. Answers were considered correct if participants provided the exact caloric amount per serving. Participants also rated how healthy they thought each individual product was, how good it would taste, and the likelihood that they would buy the product for themselves and their children (only for those who reported having children) using a 9-point Likert-type scale. Each set of ratings was averaged across all eight products.

Consumer label preferences.

At the end of the survey, participants answered questions about the label they saw, with the exception of those in the control group, who were shown the Facts Up Front+ label. This allowed for



Figure 1. Front-of-package food labels tested

Note: Facts Up Front displays grams/milligrams and % daily value information for various nutrients; Traffic Light uses an interpretive color-coded scheme to alert consumers to low, medium, and high levels of certain nutrients. Traffic Light+ is the Traffic Light label plus “nutrients to encourage” information; Facts Up Front+ is the Facts Up Front label plus “nutrients to encourage” information.

Table 4. Summary of front-of-package label performance for main outcomes^a

	Traffic Light	Traffic Light+	Facts Up Front	Facts Up Front+
Nutrient quizzes				
Nutrient level			X	
Nutrient level with fiber and protein questions		X		X
Saturated fat		X		
Sugars		X		
Sodium	X	X		
Fiber		X		
Protein		X		
Calories per serving	X	X	X	X
Perceptions				
Health				
Taste				
Intent to purchase				
Consumer preferences				
Ease of interpretation and understanding		X		
Does not have too much information and does not take too much time to understand the label	X	X	X	
Least confusing	X	X	X	

^aEach X indicates the label(s) that significantly outperformed the others on that outcome. Multiple Xs indicate that those front-of-package label groups outperformed the other groups and did not significantly differ from one another. An absence of Xs indicates that none of the groups differed from the control group or one another.

Traffic Light+, Traffic Light plus information on “nutrients to encourage” (protein and fiber); Facts Up Front+, Facts Up Front plus information on “nutrients to encourage”

the examination of differences in label perception between those who used the Facts Up Front+ label to make decisions and those who saw it for the first time, without having tried to interpret it. These preference questions were measured on a 5-point Likert-type scale.

Label interpretation and understanding. A composite score reflecting ease of label interpretation and understanding was created by averaging participants' responses to the following statements (adapted from Moser et al.¹⁵):

- I feel well informed by this food label.
- This food label can help me in choosing foods.
- This food label can help me to understand the product's nutrition composition.
- This food label can help me decide what to buy.
- It is better for me to use this food label for my buying decision rather than to rely on my own knowledge of food nutrition and ingredients.

A composite score reflecting participants' perceptions of the amount of information on the label and the time it takes to understand the label was created by averaging responses to the following statements:

- This food label has too much information.
- Reading and understanding this food label takes more time than I am willing to spend.

Participants also rated, on a 9-point Likert-type scale, the degree to which they found the label confusing. At the end of the survey, participants provided demographic information, including height and weight used to calculate BMI, and indicated whether they currently were trying to lose weight and how much nutrition labels generally influence their food choices (9-point Likert-type scale).

Statistical Analyses

Data analysis was performed using SPSS, version 18.0. Continuous study outcomes were compared using one-way ANOVAs followed by post hoc Tukey tests. Chi-square tests were used to examine categorical outcome variables. Results for the 20 outcomes evaluated were considered significant if unadjusted *p*-values were less than a Bonferroni-corrected alpha level of 0.003. Significance for all other tests was assessed at an alpha level of 0.05, and all tests were two-tailed.

Exploratory two-way ANOVAs and regression models were tested to examine interactions between label condition and gender; education; weight status (normal weight versus overweight/obese [defined as BMI >25]); or age for all outcomes. The No-Label group was used as the reference category and age, gender, education, and weight status were included as independent predictors in the models.

Results

Participants

A total of 892 participants initiated the survey. The final sample included 703 participants (Figure 2). The average survey completion time for included participants was 27:52±9:49 minutes and did not differ across study groups, $F(4,698)=1.85$, $p=0.118$. The proportion of individuals excluded did not differ across conditions,

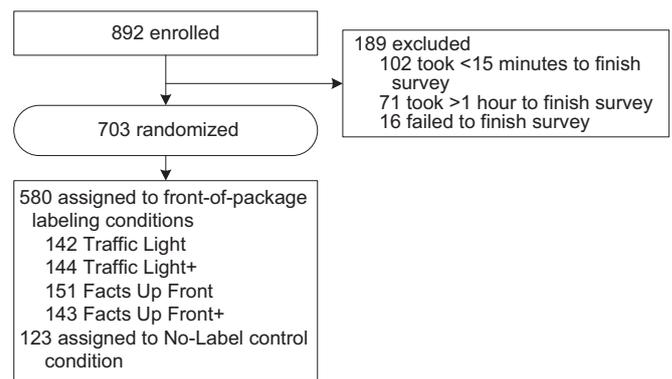


Figure 2. CONSORT flow diagram showing randomization into five labeling conditions

$\chi^2(4)=9.17$, $p=0.057$. The study groups did not differ by age, BMI, education, race/ethnicity, gender, income, or efforts to lose weight (see Table 2 for sample description).

Main Outcomes

Nutrient understanding. For the nutrient-level comparisons quiz, all label groups outperformed the No-Label group when the fiber and protein questions were excluded. Although all label groups scored >80% correct on the quiz, those in the Facts Up Front group had the best performance, which was better than both Traffic Light groups, but did not differ from the Facts Up Front+ group. When the total nutrient-level quiz scores were compared, including the fiber and protein questions, all groups outperformed the control group. The Facts Up Front+ and Traffic Light+ groups had the best overall scores and did not differ from one another. They both outperformed the Traffic Light group, but the Traffic Light+ group did not differ from the Facts Up Front group.

For the saturated fat quiz, all label groups except Facts Up Front outperformed the control group. Those in the Traffic Light+ group did better than all other groups and those in the Traffic Light group also outperformed both Facts Up Front groups. For the sugars quiz, all label groups, except the Facts Up Front+ group, outperformed the control group. The Traffic Light+ group performed better than all other groups, and the Traffic Light group did better than both Facts Up Front groups.

For the sodium quiz, all label groups outperformed the control group. Both Traffic Light groups did better than the Facts Up Front groups, but did not differ from one another. The Traffic Light+ group had the best performance. For the fiber and protein quizzes, both the Traffic Light+ and Facts Up Front+ groups outperformed the control group, which did not differ from the Traffic Light and Facts Up Front groups. The Traffic Light+ group performed better than all other groups.

Nutrient-level estimation accuracy. The Facts Up Front groups were more likely to underestimate saturated fat and sugars relative to the control group and the Traffic Light groups, which were more accurate than the control group. For the sodium quiz, all groups were more accurate than the control group, but the Facts Up Front+ group was more likely to underestimate sodium relative to the Traffic Light+ group. Both Facts Up Front groups were also more likely to overestimate fiber and protein levels relative to the Traffic Light+ group, although the Facts Up Front+ group was less likely to overestimate fiber and protein relative to the Traffic Light group, which did not differ from the control group.

All the groups outperformed the control group in ability to estimate calories per serving. However, the label groups did not differ from one another on this measure. There were no group differences in perceptions of healthfulness, taste, or intent to purchase for oneself or one's children across label conditions. There were no interactions between label condition and gender, weight status, age, or education level for any of the outcome variables.

Label interpretation and understanding. The Traffic Light+ label scored significantly higher than the other labels. Those in the control group who rated the Facts Up Front+ label at the end of the survey without having used it, believed it was as easy to interpret as the Traffic Light+ label, but it received the worst score when rated by those in the Facts Up Front+ group.

On ratings of whether the label had too much information or required too much time to understand, the Facts Up Front+ label had a worse score relative to all of the other groups, which did not differ from one another. On ratings of degree of confusion, the Facts Up Front+ label received worse ratings relative to all of the other labels, which did not differ from one another. Table 3 shows complete results, and Table 4 provides an overall summary of the key study findings.

Discussion

The findings from the present study suggest that a front-of-package nutrition label can improve the accuracy of judgments about the nutritional quality of foods and beverages. Results indicated that the Traffic Light+ and Facts Up Front labeling systems helped people determine which of two products had higher or lower levels of various nutrients. When individuals compared two products on sugar, saturated fat, and sodium levels only, the Facts Up Front system was most helpful. However, when individuals also compared products based on protein and fiber, the Facts Up Front+ and Traffic Light+ groups, which included this specific information, performed equally well.

In contrast, when participants judged the levels of specific nutrients in individual products, both versions of the Traffic Light labels were substantially more helpful than the Facts Up Front labels. The average score for those in the Traffic Light+ group was $\geq 90\%$ on all individual nutrient quizzes compared to average scores for the Facts Up Front groups, which ranged from 47% to 72% for all but the calories-per-serving estimation quiz. As expected, when protein and fiber appeared on the label, people were also better able to estimate the levels of these nutrients.

Although the Traffic Light+ label tested in the present study included information about protein and fiber, the current Facts Up Front system enables companies to select different nutrients to encourage. This is concerning because less-healthy products can appear to be healthier through highlighting of specific vitamins. An additional concern is that individuals in the current study who viewed the Facts Up Front labels were more likely to underestimate saturated fat and sugars and overestimate fiber and protein amounts in products.

Interestingly, the inclusion of nutrients to encourage on the Traffic Light label did not impair performance on the nutrient quizzes. Those in the Traffic Light+ group actually performed the best on all quizzes, even when questions did not pertain to nutrients to encourage. This suggests that displaying fiber and protein might help participants better judge other nutrient levels. It is possible that the provision of more information enables better assessment of the complete nutritional profile of a food or that a label with more information better captures and/or holds an individual's attention. However, depending on the method of presentation, too much information might be problematic as demonstrated by decreased performances when using the Facts Up Front+ label.

Moreover, although consumer preferences must be interpreted with caution because they do not always align with behavior, these findings indicated that consumers found the Traffic Light+ label to be the most user-friendly. Further, participants viewed the Facts Up Front+ label as more confusing than the other labels and as having too much information and taking too much time to understand. Finally, perceptions of health, taste, and intent to purchase were not influenced by any of the label conditions, suggesting that such labels might help to inform consumers but not change behavior.

The current study is limited because participants were drawn from an Internet panel, which introduces potential selection bias, and consumer ability to understand the labels was assessed via a computer, rather than in a real-world setting. Another limitation is that only a small number of products were examined, although a range of product types were tested. In addition, participants only made decisions between two products and assessed individual products,

rather than deciding between many different products as is often the case when food shopping.

Additionally, the present study examined consumer understanding of front-of package labels after receiving information about how to interpret labeling systems. Although food manufacturers pledged to spend \$50 million on a Facts Up Front education campaign, not everyone will be exposed to such information. Therefore, it will be important for future research to examine label understanding and use with and without educational information. Finally, interactions between label condition and weight status were based on self-reported height and weight, which is prone to measurement error.

Despite these limitations, the current study adds to the literature in several important ways. It is the first study of U.S. consumers, to our knowledge, that compares the Facts Up Front with the Traffic Light labeling system. In addition, the study examines the influence that information about “nutrients to encourage” has on evaluating the nutritional profiles of foods. The present study also has several strengths, including an RCT design and a large sample representative of the educational profile of the U.S. population.

The results suggest that a Traffic Light label that included High/Med/Low text and information about fiber and protein best assisted individuals in judging the nutritional profiles of foods and beverages. Although more research is needed to understand how such a label would perform in a real-world setting, the results suggest that the Facts Up Front labeling system could be improved by using a color-coded traffic light scheme with High/Med/Low text, rather than % DV information to best educate the public about nutrition. However, both labeling systems require further study using behavioral outcomes such as purchasing data and food consumption to inform future FDA recommendations for a uniform front-of package labeling system.

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Supplementary data

A pubcast created by the authors of this paper can be viewed at http://www.ajpmonline.org/content/video_pubcasts_collection.