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Nutrition Label Viewing during a Food-Selection Task: Front-of-Package Labels vs Nutrition Facts Labels

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ABSTRACT

Background Earlier research has identified consumer characteristics associated with viewing Nutrition Facts labels; however, little is known about those who view front-of-package nutrition labels. Front-of-package nutrition labels might appeal to more consumers than do Nutrition Facts labels, but it might be necessary to provide consumers with information about how to locate and use these labels.

Objective This study quantifies Nutrition Facts and front-of-package nutrition label viewing among American adult consumers.

Design Attention to nutrition information was measured during a food-selection task.

Participants/setting One hundred and twenty-three parents (mean age=38 years, mean body mass index [calculated as kg/m^2]=28) and one of their children (aged 6 to 9 years) selected six foods from a university laboratory-turned-grocery aisle.

Intervention Participants were randomized to conditions in which front-of-package nutrition labels were present or absent, and signage explaining front-of-package nutrition labels was present or absent.

Main outcome measures Adults' visual attention to Nutrition Facts labels and front-of-package nutrition labels was objectively measured via eye-tracking glasses.

Statistical analyses performed To examine whether there were significant differences in the percentages of participants who viewed Nutrition Facts labels vs front-of-package nutrition labels, McNemar's tests were conducted across all participants, as well as within various sociodemographic categories. To determine whether hypothesized factors, such as health literacy and education, had stronger relationships with front-of-package nutrition label vs Nutrition Facts label viewing, linear regression assessed the magnitude of relationships between theoretically and empirically derived factors and each type of label viewing.

Results Overall, front-of-package nutrition labels were more likely to be viewed than Nutrition Facts labels; however, for all subgroups, higher rates of front-of-package nutrition label viewership occurred only when signage was present drawing attention to the presence and meaning of front-of-package nutrition labels.

Conclusions Consumers should receive education about the availability and use of new nutrition labels.
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OBESITY AND ITS ASSOCIATED HEALTH PROBLEMS are significant public health concerns in the United States. The National Health and Nutrition Examination Survey reveals that more than one-third of US adults and nearly one-fifth of youth were obese in 2011 to 2012.[1] Obesity contributes to the development of heart disease, type 2 diabetes, cancers, and other negative health outcomes.[2] Attention to nutrition, including reading food labels, can be an effective way to improve dietary behaviors and prevent these weight-related chronic diseases.[3] Use of nutrition information on food labels is associated with lower fat intake,[4] consumption of diets higher in vitamin C and lower in cholesterol,[5] higher fiber and iron intake,[6] and less sugar consumption.[3]

A large body of existing research describes characteristics of consumers who use Nutrition Facts labels and other side- or back-of-package nutrition labels.[7,8] Greater use of side- or back-of-package nutrition labels is associated with demographic characteristics (ie, being female, being married, being younger relative to older, having some college education, and living with others), as well as beliefs and behaviors

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(ie, having more nutrition knowledge; believing that a healthy diet is important; having higher diet-specific self-efficacy; believing that diet is related to health outcomes, including cancer; placing a higher priority on product safety and nutrition than taste; and actively trying to lose weight).[4,5,9-13]

Relative to Nutrition Facts label users, less is known about the characteristics of consumers who use front-of-package nutrition labels. Existing research indicates that front-of-package nutrition labels are well received by consumers[14,15] and better understood than Nutrition Facts labels.[16] Up to 87.5% of consumers are able to identify the healthiest of three foods via front-of-package nutrition labels.[17] Rates of identifying healthier choices using Nutrition Facts labels tend to be substantially lower.[7,8] In light of the policy attention currently given to front-of-package nutrition labels in the United States,[18] and given that the US Food and Drug Administration is considering what type of front-of-package nutrition labels, if any, to require on food packaging,[19] it is imperative to understand front-of-package nutrition label use among US consumers. Although it is possible that only those same motivated consumers who use Nutrition Facts labels will use front-of-package nutrition labels, there are reasons to hypothesize otherwise. For example, consumers are less likely to view nutrition information located on the back or side of a package vs the front,[15] and when nutrition information is made readily available, most individuals tend to view it.[20]

In addition, as previous research has found a positive association between health/nutrition concern and label use,[4,5,10] consumers with lower overall health concern often do not intentionally seek out Nutrition Facts label information. However, these consumers might be impacted by seeing nutrition information on the front of packages, even if they did not intend to view it there. Research indicates that even when individuals are not overly concerned with healthy eating, they do eat more healthfully if they read Nutrition Facts labels.[21]

An additional subset of consumers who may be more likely to use front-of-package nutrition labels than Nutrition Facts labels are those with lower levels of literacy and numeracy.[22] Poor label comprehension correlates with lower literacy and numeracy skills, and even those with higher literacy may have difficulty interpreting Nutrition Facts labels.[23] Consumers with lower literacy and numeracy might not understand the relatively more complex Nutrition Facts label format and therefore might not use Nutrition Facts labels. Such consumers might find it easier to use the relatively less complex front-of-package nutrition labels, particularly those with simplifying heuristic strategies, such as colors and symbols for conveying nutrition information. A recent review of eye-tracking research examining various types of nutrition labels reports that consumers better understand labels that are color-coded (rather than monochromatic), such as traffic-light labels, with red, yellow, and green indicators for levels of healthfulness among key nutrients.[24] Therefore, front-of-package nutrition labels that use heuristic strategies may reach consumers who do not understand the Nutrition Facts label's more complex numerical layout.

In light of the theoretical and empirical indications that front-of-package nutrition labels may be seen by and appeal to more types of consumers than Nutrition Facts labels, the present study hypothesized that consumers would be more likely to view front-of-package nutrition labels vs Nutrition Facts labels during a food-selection task. The present study also examined the extent to which two different front-of-package nutrition label formats would be viewed by consumers in a food-selection context in the absence of any explanation of these labels, and whether it would be necessary to draw attention to and explain these labels (using in-aisle signage) in order for these front-of-package nutrition labels to be viewed by consumers while selecting foods. It was further hypothesized that multiple traffic-light labels (which have a colorful, readily interpretable design) would be viewed more than the monochromatic Facts Up Front labels (introduced by the Grocery Manufacturers Association and Food Marketing Institute as Nutrition Keys in January 2011[25] and since renamed), both in the presence and absence of explanatory signage. A third hypothesis proposed that in-aisle signage describing front-of-package nutrition labels would increase consumer attention to the front-of-package nutrition labels, but not to nutrition information more generally (ie, not Nutrition Facts labels). Finally, it was proposed that a broader spectrum of consumers (eg, spanning a wider array of education, general health concern, and health literacy levels) would view front-of-package nutrition labels vs Nutrition Facts labels.

MATERIALS AND METHODS

Setting

This study was conducted at the University of Minnesota's Epidemiology Clinical Research Center between June 2012 and April 2013. An office set up to resemble a grocery store aisle contained 90 products placed in the approximate locations that they occupied at a popular local grocery store.

Participants

Parent/child pairs (n=155) were recruited via a variety of electronic, print, and in-person means in the Twin Cities, MN, area for a study of "family food preferences." Child participants were between 6 and 9 years of age. Parents were screened by phone and excluded if they were unable to read and write in English. Potential participants were informed during the telephone screening that the study would involve selecting foods to take home from a laboratory grocery aisle. They were also informed that both parent and child would wear eye-tracking glasses (Tobii) during the food-selection task. Potential participants were told that the eye-tracking glasses would record video and audio so the researchers would be able to see what participants looked at and hear what they said while selecting foods. Those who were eligible to participate were scheduled for a one-time 1-hour laboratory visit. Upon arrival for the visit, participants provided written consent (parent) and assent (child) to participate. All procedures were approved by the University of Minnesota's Institutional Review Board.

Participants were randomly assigned to select foods from a grocery aisle configured in one of five ways, based on a 2 (front-of-package nutrition label type: Facts Up Front [see Figure, panel A] or multiple traffic-light labels featuring the same format as the Facts Up Front labels, but using red, amber, and green color-coding to reflect high, medium, and low levels of three key nutrients to limit, saturated fat, sodium, and sugar [see Figure, panel B])×2 (in-aisle signage explaining front-of-package nutrition labels: present or

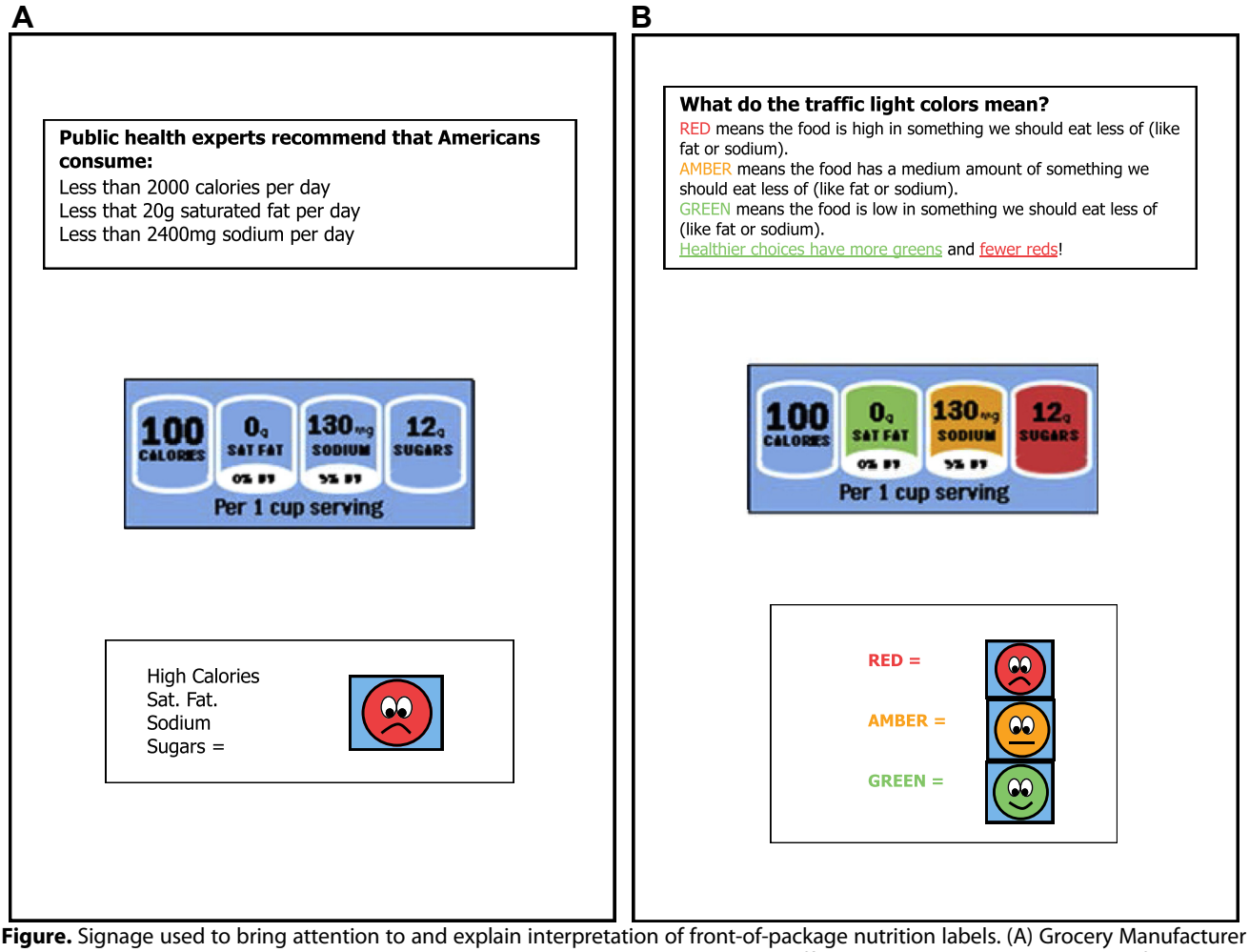

Figure. Signage used to bring attention to and explain interpretation of front-of-package nutrition labels. (A) Grocery Manufacturer Association's label known as both Nutrition Keys and Facts Up Front. (B) Multiple traffic-light label using the same label format, but also including red, amber, and green color coding to indicate high, medium, and low levels of key nutrients-to-limit.

absent)+1 (control group: no front-of-package nutrition labels, no signage) design. All five groups had access to Nutrition Facts labels; however, as the study's purpose was to explore whether front-of-package nutrition label viewers differ from Nutrition Facts label viewers, the control group did not have front-of-package nutrition labels to view and, thus, was excluded from these statistical analyses. Therefore, the final analytic sample size was 123.

Procedures

Both parent and child participants were weighed and measured by research staff using a standard, calibrated scale (Tanita digital scale, BWB-800A Class III) and stadiometer (Pharmacia & Upjohn) before beginning the food-selection task in a separate room. Height and weight were used to determine body mass index (calculated as kg/m^2). Before entering the simulated grocery aisle, participants were instructed to select two foods from each of three labeled sections within the aisle: cereals, crackers/cookies, and chips/snacks, for a total of six foods that they would take home. Each of the three sections of the grocery aisle contained approximately 30 food options from which participants could choose. Foods included in the study were common in local grocery stores and included products with variability in levels of saturated fat, sodium, and sugar within each category. After receiving instructions, participants entered the grocery aisle; researchers closed the door and remained outside until participants finished making their selections.

Measures

After the food-selection task, participants completed a questionnaire comprised of demographic items (self-reported sex, race and ethnicity, education, annual household income, and marital status), diet-related items compiled especially for this study (dietary restrictions, perceived importance of purchasing healthy foods, typical nutrition label use, and proportion of the grocery shopping for themselves and those with whom they lived for which they were responsible), and sports or recreational physical activities in which they participated during the past week. The self-reported physical activities in which participants engaged during the past week were transformed into metabolic equivalent (MET) minutes by identifying the MET intensity in the compendium of physical activity intensities,[26] multiplying this by the number of times

the participant reported engaging in the activity and by the number of reported minutes per bout of this activity. MET minutes of all reported activities for the previous week were summed, and this measure was median split at 75 MET min/wk for analyses. Parents also completed the validated Newest Vital Sign assessment to provide a measure of health literacy.[27] This tool provides participants with a Nutrition Facts label and a list of ingredients and asks six comprehension questions (eg, if you eat the entire container, how many calories will you eat?).

Analyses

McNemar's tests were used to compare the percentage of adult participants who viewed Nutrition Facts labels vs front-of-package nutrition labels. In order to test whether multiple traffic-light labels would be viewed more than Facts Up Front labels in both the presence and absence of explanatory signage, the rates of front-of-package nutrition label viewing were compared in the presence and absence of explanatory in-aisle signage, again using McNemar's tests. To test whether in-aisle signage explaining front-of-package nutrition labeling would increase consumer attention to front-of-package nutrition labels, but not Nutrition Facts labels, χ^2 analyses were performed to compare the percent of participants who viewed Nutrition Facts labels and front-of-package nutrition labels both in the presence and absence of in-aisle signage explaining the front-of-package nutrition labels.

McNemar's tests were also used to compare the percentages of adult participants who viewed Nutrition Facts labels vs front-of-package nutrition labels within various sociodemographic groups. Because 27 tests were conducted, a Bonferroni adjustment (α=.002) was used to establish the level of statistical significance for determining whether a between-group difference was likely due to chance. In order to further investigate whether hypothesized relationships existed, such that factors including health literacy and health concern would have a stronger relationship with Nutrition Facts label viewing than with front-of-package nutrition label viewing, a series of four multiple linear regression models were fit to assess the magnitude of the relationships between 15 factors linked by theory and/or prior research results to the use of nutrition information and Nutrition Facts label and front-of-package nutrition label viewing in this sample. The four models had as their dependent variables mean amount of time spent viewing Nutrition Facts labels, mean time spent viewing front-of-package nutrition labels, and two dichotomous variables indicating whether or not the adult participant viewed at least one Nutrition Facts label (1=yes) and at least one front-of-package nutrition label (1=yes), respectively. The sample was determined via power analysis to be sufficiently large to detect medium (.87) and large effects (.9995) in the linear regression analyses, but had less than adequate power (.14) to detect small effects.

RESULTS

Parent characteristics are summarized in Table 1. Parents had a mean age of 38.14 years and a mean body mass index of 27.87. The majority of participants were female (87.8%), white (82.4%), married (76.2%), and their household's primary food shopper (90.5%). All consumers were more likely to view front-of-package nutrition labels (63%) compared with Nutrition Facts labels (42%) (Table 2). Twenty-eight percent of participants viewed both label types (≥1 Nutrition Facts label and ≥1 front-of-package nutrition label) during the shopping task, while 23% viewed neither a Nutrition Facts label nor a front-of-package nutrition label (data not shown).

Rates of front-of-package nutrition label viewing did not differ significantly across the two front-of-package nutrition label types, either with explanatory signage (Facts Up Front: 93%, multiple traffic light: 97%; χ^2=.58; P=0.447) or without explanatory signage (Facts Up Front: 24%, multiple traffic light: 31%; χ^2=.31; P=0.576) (data not shown). The percentages of participants who viewed ≥1 Nutrition Facts label were not significantly different, regardless of access to front-of-package nutrition label signage; specifically, 47% of participants with signage viewed ≥1 Nutrition Facts label vs 37% of participants without signage (Table 2); χ^2=1.16; P=0.282. Among participants who had access to signage explaining front-of-package nutrition labels, 95% viewed ≥1 front-of-package nutrition label, whereas among participants without signage, only 27% viewed ≥1 front-of-package nutrition label (χ^2=60.98; P<0.001). Within the group with access to the signage, there was a significant difference (χ^2=25.71; P<0.001) between the percent of participants viewing Nutrition Facts labels (47%) and front-of-package nutrition labels (95%); but for the group without access to front-of-package nutrition label signage, there was no significant difference (χ^2=.96; P=0.327) between the percent who viewed Nutrition Facts labels (37%) and front-of-package nutrition labels (27%). None of the demographic subgroups tested showed significantly higher rates of front-of-package nutrition label viewing compared with Nutrition Facts label viewing when using the Bonferroni-adjusted level of statistical significance (Table 2, all participants).

Because front-of-package nutrition label viewing differed by explanatory signage condition, analyses examining Nutrition Facts label and front-of-package nutrition label viewing were rerun separately for participants assigned to select foods from a grocery aisle containing (n=64) or not containing (n=59) signage. Patterns of Nutrition Facts label and front-of-package nutrition label viewing among those with and without in-aisle signage were similar for each sociodemographic group examined: Among participants with access to front-of-package nutrition label explanatory signage, front-of-package nutrition label viewing was >90% for all subgroups and significantly higher than rates of Nutrition Facts label viewing (P<0.002) for nearly all of these groups. For the participants randomly assigned to the no in-aisle front-of-package nutrition label signage condition, rates of front-of-package nutrition label viewing for all aforementioned sociodemographic subgroups were significantly lower (between 34% and 59%), and not significantly different from rates of Nutrition Facts label viewing (Table 2).

Regression coefficients for each factor associated with Nutrition Facts label and front-of-package nutrition label viewing are displayed in Table 3 by label type (and, within label type, by both whether or not labels were viewed at all and amount of viewing time). Only physical activity was significantly associated with higher mean viewing time for both Nutrition Facts labels and front-of-package nutrition labels, indicating that, after accounting for all other factors, more physically active participants viewed both types of labels for a longer period of time than did less-active

Table 1. Sociodemographic and lifestyle factors for American adult participants in laboratory food-selection task

Sociodemographic and lifestyle factors	Analytic sample (n = 123)
	←*mean±standard deviation*→
Age, y	38.18±6.41
Body mass index	28.07±7.05
	←————*n (%)*————→
Female sex	102 (86.4)
White race	99 (80.5)
Hispanic ethnicity	2 (1.6)
Education	
<4-y college	50 (42.4)
4-y college degree	42 (35.6)
>4-y college	26 (22.0)
Annual income, $	
<25,000-50,000	37 (31.4)
50,001-75,000	27 (22.9)
75,001-100,000	32 (27.1)
>100,000	22 (18.6)
Marital status	
Married	88 (75.2)
Not married	29 (24.8)
Dietary restrictions for self or other in household	
None	84 (68.3)
1 or more	39 (31.7)
Perceived importance of healthy eating	
Somewhat important	27 (23.3)
Important	43 (37.1)
Very important	46 (39.7)
Self-reported label use	
Never or rarely	11 (9.3)
Sometimes	53 (44.9)
Often	25 (21.2)
Always or almost always	29 (24.6)
Proportion of food shopping for household	
Very little or none	3 (2.5)
Some, not most	10 (8.5)
Most	49 (41.5)
All	56 (47.5)
Health literacy (newest vital sign)	
6 of 6 correct answers	62 (50.4)
<6 of 6 correct answers	61 (49.6)
Physical activity (MET[a] min/wk)	
≤75	61 (49.6)
>75	62 (50.4)

[a]MET=metabolic equivalent.

participants. Self-reported label use significantly predicted whether or not participants actually viewed Nutrition Facts labels during the task, but the same was not true for front-of-package nutrition labels. This indicates that those who reported using labels when selecting foods for purchase were more likely to view the Nutrition Facts label, but not the front-of-package nutrition label, after controlling for the other model variables. Perceived importance of purchasing healthy foods also significantly predicted Nutrition Facts label viewing, but not front-of-package nutrition label viewing. Indeed, for front-of-package nutrition labels, only the presence of in-aisle signage explaining the front-of-package nutrition labels significantly predicted whether participants viewed these labels, with participants in the signage condition being significantly more likely to view front-of-package nutrition labels. Due to the sizable contribution to the model made by the presence of explanatory signage, this regression model predicting whether or not participants viewed front-of-package nutrition labels produced a substantially larger R^2_{adjusted} (0.488) than any of the other models, which produced R^2_{adjusted} values ranging from 0.006 to 0.064.

DISCUSSION

This study tested four hypotheses related to front-of-package nutrition label use and found substantial support for two of these hypotheses: front-of-package nutrition label viewing was found to be greater than Nutrition Facts label viewing, and in-aisle signage explaining front-of-package nutrition labels did increase consumer attention to front-of-package nutrition labels. The hypothesis that a broader spectrum of consumers would view front-of-package nutrition labels relative to Nutrition Facts labels was partially supported, as this was only true for participants exposed to in-aisle signage. Finally, the hypothesis that multiple traffic-light labels would receive more consumer attention than Facts Up Front labels was not supported by these data.

It was proposed that, because front-of-package nutrition labels are easier to see and use than Nutrition Facts labels, more consumers would view front-of-package nutrition labels relative to Nutrition Facts labels. Consistent with literature demonstrating that consumers exert low levels of effort in making dietary decisions,[15] the present results provided support for this hypothesis, as 63% of participants viewed at least one front-of-package nutrition label, which can be seen without touching a food package, and only 42% viewed at least one Nutrition Facts label, which can only be seen if a consumer picks up and rotates a food package to see the side panel.

Next, consistent with previous work suggesting that consumers show higher levels of both liking and understanding traffic-light style front-of-package nutrition labels compared with other formats,[14,28-30] and are more likely to attend to more visually salient nutrition labels, for example, those that are more colorful,[24] it was hypothesized that multiple traffic-light labels would be viewed more than Facts Up Front labels. The data did not support these contentions, as multiple traffic-light and Facts Up Front labels received comparable consumer attention in aisles both with and without explanatory signage. A possible explanation for this result is that existing research on multiple traffic-light labels has primarily examined European consumers[14,28,30] and American consumers are likely to be less familiar with this label format than with the Facts Up Front format.

In addition, it was hypothesized that in-aisle signage identifying and describing front-of-package nutrition labels would uniquely increase front-of-package nutrition label viewing rather than promoting a more general interest in nutrition information that would be reflected in increased attention to both front-of-package nutrition labels and Nutrition Facts labels. In support of this hypothesis, Nutrition Facts label viewing was statistically equivalent across the groups with and without access to front-of-package nutrition label explanatory signage, and front-of-package nutrition label viewing was dramatically higher among participants with access to signage.

There are multiple possible interpretations of the finding that explanatory signage substantially increased consumers' viewing of front-of-package nutrition labels. One interpretation is that increased front-of-package nutrition label viewing in the presence of explanatory signage indicates that signage was necessary to point out to consumers the presence of new, unfamiliar labels. However, it should be noted that label formats used in this study should be at least somewhat familiar to American consumers. The Facts Up Front labels (Figure, panel A) had already been adopted by the US food industry and added to many food packages before the study period; thus, participants were likely to have previously encountered products bearing these labels. Similarly, the multiple traffic-light labels (Figure, panel B), although not in use in the United States, resembled Facts Up Front labels in all ways but color, and so should have been familiar in content and location to consumers aware of Facts Up Front labels. Given the likelihood that many consumers had previously encountered identical or similar front-of-package nutrition labels, it is possible to interpret the present findings as indicating that in-aisle signage served as a prompt to consumers to view these front-of-package nutrition labels, or an explanation of how to interpret them, rather than a first introduction to the labels. It is also possible that the signage served a combination of purposes; for example, as an introduction to front-of-package nutrition labels, a behavioral prompt to use front-of-package nutrition labels, and as an explanation for how to interpret front-of-package nutrition labels.

Finally, although front-of-package nutrition labels were viewed by significantly more participants than Nutrition Facts labels, this overall effect was driven by the presence of signage in the grocery aisle pointing out and explaining the front-of-package nutrition labels. For the participants randomly assigned to select products from a grocery aisle that had front-of-package nutrition labels on products, but no explanatory signage, participants as a whole or within any subgroup tested were not more likely to view front-of-package nutrition labels than Nutrition Facts labels.

Consumer characteristics related to front-of-package nutrition label use have received little empirical attention[31]; thus, the present study provides some of the first relevant research. Of note, those who self-reported higher rates of label use when selecting foods were more likely to view Nutrition Facts labels, but not front-of-package nutrition labels. Inconsistencies between self-reported and observed use of nutrition information are not uncommon in the literature[7]; however, the present results may not represent such an inconsistency, given that front-of-package nutrition labels are still not widely available on US food packages. Only Nutrition Facts labels are required to appear on US food packaging, so

Table 2. Percent of American adult participants (n=123) viewing Nutrition Facts labels and front-of-package labels in food-selection task (among all participants, and by presence/absence of in-aisle signage explaining front-of-package labels)

	All Participants				Participants with Signage				Participants without Signage			
Characteristics	n	Viewed[a] Nutrition Facts Labels	Viewed[a] Front-of Package Labels	*P* value[b]	n	Viewed[a] Nutrition Facts Labels	Viewed[a] Front-of Package Labels	*P* value[b]	n	Viewed[a] Nutrition Facts Labels	Viewed[a] Front-of Package Labels	*P* value[b]
		←——%——→				←——%——→				←——%——→		
All participants	123	42	63	**0.002**	64	47	95	**<0.001**	59	37	27	0.327
Age ≥38 y	68	43	62	0.037	38	45	92	**<0.001**	30	40	23	0.227
Age <38 y	55	42	64	0.038	26	50	100	**<0.001**	29	34	31	1.00
BMI[c] >25	78	37	59	0.010	39	41	95	**<0.001**	39	33	23	0.454
BMI ≤25	54	50	69	0.078	28	50	96	**0.001**	26	50	38	0.549
Female	102	41	62	0.007	50	42	98	**<0.001**	52	40	27	0.230
Male	16	44	69	0.125	11	64	91	0.250	5	0	20	1.00
White, non-Hispanic	99	42	64	0.005	50	46	96	**<0.001**	49	39	31	0.541
Non-whites	24	42	58	0.344	14	50	93	0.070	10	30	10	0.500
≥4 y college	68	41	57	0.082	31	45	97	**<0.001**	37	38	24	0.332
<4 y college	50	42	70	0.011	30	47	97	**<0.001**	20	35	30	1.00
>$75,000 household income	54	44	57	0.230	24	50	92	0.006	30	40	30	0.581
≤$75,000 household income	64	39	67	0.004	37	43	100	**<0.001**	27	33	22	0.581
Married	88	44	60	0.045	42	50	95	**<0.001**	46	39	28	0.383
Nonmarried	29	34	69	0.021	18	39	100	**0.001**	11	27	18	1.00
≥1 Dietary restrictions	39	46	59	0.332	19	53	95	0.021	20	40	25	0.453
0 Dietary restrictions	84	40	64	0.004	45	44	96	**<0.001**	39	36	28	0.648
High healthy eating importance[d]	46	39	67	0.015	25	44	100	**<0.001**	21	33	29	1.00
Low healthy eating importance[d]	70	43	59	0.082	34	47	94	**<0.001**	36	39	25	0.302
High self-reported label use[e]	54	48	70	0.038	33	52	97	**<0.001**	21	43	29	0.549
Low self-reported label use[e]	64	36	56	0.031	28	39	96	**<0.001**	36	33	25	0.607
Those who do all shopping[f]	56	45	64	0.072	29	45	97	**<0.001**	27	44	30	0.424
Those who do less than all shopping[f]	62	39	61	0.014	32	47	97	**<0.001**	30	30	23	0.774

(*continued on next page*)

Table 2. Percent of American adult participants (n=123) viewing Nutrition Facts labels and front-of-package labels in food-selection task (among all participants, and by presence/absence of in-aisle signage explaining front-of-package labels) (*continued*)

	All Participants				Participants with Signage				Participants without Signage			
Characteristics	n	Viewed[a] Nutrition Facts Labels	Viewed[a] Front-of Package Labels	*P* value[b]	n	Viewed[a] Nutrition Facts Labels	Viewed[a] Front-of Package Labels	*P* value[b]	n	Viewed[a] Nutrition Facts Labels	Viewed[a] Front-of Package Labels	*P* value[b]
		←——%——→				←——%——→				←——%——→		
High NVS[g] literacy score	62	37	61	0.018	32	34	97	**<0.001**	30	40	23	0.267
Low NVS literacy score	61	48	64	0.078	32	59	94	0.003	29	34	31	1.00
Physical activity												
≥75 MET[h] min/wk[i]	62	45	65	0.052	31	52	94	**0.001**	31	39	35	1.00
Physical activity												
≥75 MET min/wk[i]	61	39	61	0.026	33	42	97	**<0.001**	28	36	18	0.180

[a]Viewing labels was dichotomized into those who viewed one or more labels within each label type (Nutrition Facts or front-of-package labels) vs those who did not view any labels of that type.

[b]A Bonferroni-adjusted *P* value of 0.002 was used to evaluate statistical significance. Bold type indicates $P<0.002$.

[c]BMI=body mass index (calculated as kg/m^2).

[d]Perceived importance of purchasing healthy foods was reported from 1=not at all important, to 4=very important; for analyses, those who indicated that it was "very important" to purchase healthy foods were compared with those who chose any of the other options.

[e]Typical nutrition label use was reported from 1=never or rarely, to 4=always or almost always; for analyses, those who responded 1 or 2 were considered "low" label users with those who responded 3 or 4 were considered "high" label users.

[f]Parents self-reported what proportion of the grocery shopping they did for themselves and those they lived with from 1=very little or none, to 4=all; for analyses, those who said they did "all" of the shopping were compared with those who did less than all of the shopping.

[g]NVS=Newest Vital Sign; used to provide a measure of participants' health literacy.[27] Participants' scores on this measure range from 0 to 6, and for the present analyses those participants who answered all 6 questions correctly were compared with those who answered five or fewer questions correctly.

[h]MET=metabolic equivalent.

[i]Participants self-reported any sports or recreational physical activities in which they participated during the past week; for each activity they indicated the type of activity, the number of times they did this activity in the previous week, and the mean minutes per episode. Using this information and the compendium of physical activity intensities,[26] the total number of MET minutes of physical activity was calculated for the previous week. This physical activity measure was median split at 75 MET minutes per week for analyses.

Table 3. Linear regression predicting visual attention to nutrition labels (Nutrition Facts labels and front-of-package labels) for 123 American adults in a food-selection task

	Nutrition Facts Label Mean Viewing[a]		Front-of-Package Label Mean Viewing[a]		Nutrition Facts Label Viewing (Yes/No)[b]		Front-of-Package Label Viewing (Yes/No)[b]	
Variables/predictors	β (SE[c])	*P* value	β (SE)	*P* value	β (SE)	*P* value	β (SE)	*P* value
Age (y)	.02 (.06)	0.727	−.01 (.02)	0.924	.01 (.01)	0.928	−.01 (.01)	0.467
BMI[d]	−.07 (.05)	0.163	−.01 (.01)	0.414	−.01 (.01)	0.28	−.01 (.01)	.729
Sex (male=0)	−.32 (1.27)	0.800	.24 (.35)	0.490	−.07 (.19)	0.721	.03 (.13)	0.841
White, non-Hispanic race (0=other)	.71 (.96)	0.463	.05 (.26)	0.841	.02 (.14)	0.890	.11 (.10)	0.288
Education[e]	.19 (.38)	0.615	−.08 (.11)	0.453	.01 (.06)	0.798	−.01 (.04)	0.729
Income[f]	−.22 (.28)	0.434	.02 (.08)	0.844	.01 (.04)	0.727	−.01 (.03)	0.927
Marital status (0=unmarried)	.30 (.95)	0.757	.23 (.26)	0.378	.09 (.14)	0.501	.03 (.10)	0.783
Dietary restrictions (0=none)	.04 (.73)	0.961	.19 (.20)	0.355	.001 (.11)	0.998	−.01 (.08)	0.987
Importance of purchasing healthy foods[g]	−.43 (.52)	0.407	−.09 (.14)	0.544	−.17 (.08)	0.028*	.03 (.05)	0.648
Self-reported label use[h]	.54 (.42)	0.208	−.07 (.12)	0.570	.15 (.06)	0.021*	.01 (.05)	0.944
Proportion of shopping[i]	.12 (.59)	0.834	.01 (.16)	0.944	.08 (.09)	0.387	.05 (.06)	0.460
Nutrition literacy[j]	.02 (.30)	0.945	.09 (.08)	0.280	−.01 (.04)	0.840	−.01 (.03)	0.927
Physical activity[k]	.001 (.01)	0.005*	.001 (.01)	<0.001*	.001 (.01)	0.113	.001 (.01)	.294
Signage (absent=0)	.68 (.68)	0.317	.33 (.19)	0.075	.11 (.10)	0.288	.71 (.07)	<0.001*
$R^2_{adjusted}$	.019		.064		.006		.488	

[a]Viewing time was measured in milliseconds.
[b]Viewing labels was dichotomized into viewing vs not viewing one or more labels within each label type.
[c]SE=standard error.
[d]BMI=body mass index; calculated as kg/m^2.
[e]Highest level of parent education reported from 1=did not complete high school, to 6=graduate or professional education.
[f]Household income was reported from 1=<$25,000, to 7=>$150,000.
[g]Perceived importance of purchasing healthy foods was reported from 1=not at all important, to 4=very important.
[h]Typical nutrition label use was reported from 1=never or rarely, to 4=always or almost always.
[i]Parents self-reported what proportion of the grocery shopping they did for themselves and those they lived with from 1=very little or none, to 4=all.
[j]The Newest Vital Sign assessed health literacy.[27] Scores on this measure range from 0 to 6 correct answers.
[k]Participants self-reported any sports or recreational physical activities in which they participated during the past week; for each activity they indicated the type of activity, the number of times they did this activity in the previous week, and the mean minutes per episode. Using this information and the compendium of physical activity intensities,[26] the total number of MET minutes of physical activity was calculated for the previous week.
*$P<0.05$.

consumers self-reporting nutrition label use would likely be referring to Nutrition Facts labels; as such, their self-reported behavior should most closely align with observed behavior surrounding Nutrition Facts labels, rather than front-of-package nutrition labels. It should also be noted that those individuals who reported using labels may be seeking more detailed nutrition information that is not included on the front-of-package nutrition label, such as cholesterol, protein, fiber, etc.

When interpreting the present results, several strengths and limitations should be considered. One strength was the use of eye-tracking glasses to objectively measure participants' attention to nutrition information. Another strength was the controlled laboratory setting in which all environmental elements were held constant, save for the presence of front-of-package nutrition labels and explanatory signage. This level of control permitted identifying the randomly assigned participant condition as the cause of any observed differences in visual attention to nutrition information. Finally, by providing participants instructions to behave as they normally would when grocery shopping and by allowing participants to actually take home their chosen foods, the study's realism was enhanced; thus, participant behavior could be expected to better represent real-life behavior than if these measures were not taken. In pretesting, parents choosing foods indicated that they behaved differently than during typical shopping because they were not keeping track of a child while completing the task; therefore, steps to enhance realism and real-world constraints on nutrition label use were further addressed in the present study by requiring that parents complete the food-selection task with a child.

Along with these strengths, the present study had limitations, including participants' awareness that they were involved in a research study, which might have led to artificial behaviors, despite the aforementioned attempts to promote realism. Although no mention was made of health or

nutrition until participants answered survey questions after the food-selection task, it is possible that certain study elements, such as being weighed, wearing eye-tracking glasses, and presence of a child, may have led participants to pay more attention to nutrition labels than they would outside of the laboratory. There is mixed evidence for the impact of weighing on weight-related behaviors and outcomes, with some intervention research indicating that self-weighing can reduce both caloric intake and body weight,[32-34] and some suggesting otherwise.[35] In addition, it is unclear what the short-term impact of weighing might have been in this study, as it is not clear whether the mechanism linking weighing to dietary behavior requires repeated weighing (eg, to monitor how diet change relates to weight change[36]) or whether a single weighing can produce behavior change. The latter is supported by objective self-awareness theory[37] in which directing attention toward the self, as during weighing, can cue behavior consistent with one's values, such as healthy eating.

Knowing that visual attention was being monitored via eye-tracking glasses might have motivated participants to view nutrition information, although previous work by the study team suggests that the mere presence of an eye-tracking camera is not sufficient to increase consumer attention to nutrition information to levels even as high as those self-reported by the same individuals.[38] It is also possible that the presence of a child could have impacted adults' behaviors, such as viewing nutrition information, as previous research has demonstrated that adults thinking about making food choices related to children's (vs adults') diets tend to adopt a greater focus on nutrition.[39] The present results might reflect only the subset of adult food-shopping trips made with a child, and not those trips made without a child.

Because consumers were not asked to describe whether or how they used the in-aisle signage, the possible reasons why these signs may have increased attention to front-of-package nutrition labeling are unclear. There is a sizable body of research demonstrating that individuals do not always possess accurate insight about their own behaviors[40]; thus, experimental tests of possible explanations for signage effects may be more useful than interviews. It could also be advantageous to test whether in-aisle signage pertaining to nutrition information would increase attention to existing information (eg, Nutrition Facts labels), as well as to newly introduced, unfamiliar information, such as novel front-of-package nutrition labels. Recent work suggests that messages prompting parents to view nutrition information appearing in locations other than the front of food packages can also serve as cues that trigger increased viewing of existing nutrition information, such as Nutrition Facts labels[41]; thus, in-aisle signage promoting Nutrition Facts label use could also serve as a low-cost intervention to enhance consumer utilization of an existing nutrition resource.

Because the present study included only participants able to read and write in English, the results may not generalize to those with lower levels of English fluency. It will be important in future research to test how front-of-package nutrition labeling impacts the food choices made not only by those who are fluent in English, but also by those who are not. Label designs that are best able to promote healthy eating among large portions of the population are likely to be those that can convey health information to individuals spanning levels of English literacy.

Finally, the ability of future research to disentangle possible causes of increased front-of-package nutrition label viewership in the presence of explanatory signage (eg, introducing, prompting, and educating) might suggest different courses of action for interventionists seeking to optimize not only label use, but also healthy food choices. For example, messaging consumers at point-of-purchase might be a preferred strategy if prompting or reminding consumers to use labels is the top priority, and informing consumers about labeling via mass media may be indicated if education is required.

CONCLUSIONS

In the present study, front-of-package nutrition labels were more likely to be viewed than Nutrition Facts labels by adults during a food-selection task; however, these higher rates of front-of-package nutrition label viewership occurred only when signage was present in the grocery aisle pointing out and explaining the front-of-package nutrition labels. This result suggests that consumer attention to front-of-package nutrition labeling would be increased by informational campaigns educating consumers on the availability of this resource and how to use it.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

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