Supplementary Table 3. Nutrient and Front-of-Pack Labels

Observational Studies of Consumer Behavior

Author, y	Design	Population	Duration	Intervention/Evaluation	Major Findings
Neuhouser et al, 1999[89]	Observational, cross-sectional	N=1450 adult residents of Washington state	September 1995–September 1996	The questionnaire assessed use of nutrition labels, fat-related diet habits, fruit and vegetable consumption, diet-related psychosocial factors, health behavior, and demographic characteristics.	• Use of nutrition labels was significantly higher among women, residents age <35 y, and residents with more than a high school education. • When controlled for demographic factors, the strongest predictors of label use were belief in the importance of eating a low-fat diet, belief in an association between diet and cancer, and being in the maintenance stage of change for adopting a low-fat diet. • Label use was significantly associated with lower fat intake and, after adjusting for all demographic, psychosocial, and behavioral variables, explained 6% of the variance in fat intake ($P<0.001$). • Label use was not associated with fruit and vegetable consumption.
Weaver and Finke, 2003[93]	Observational, cross-sectional	N=5765 respondents age 20+ y who completed both the CSFII and the DHKS	1994-1996	Self-reported data from a population-based cross-sectional survey. This study modeled total consumption of added sugar. Respondents' consumption of these added sugars was originally measured in teaspoons. As a dependent variable in this model, added sugar consumption was measured as a percentage of food density so that persons with different caloric needs and intakes could be compared more accurately. The results indicate which persons are receiving a larger proportion of daily energy intake from sugar.	• The average proportion of food energy from added sugars for the entire sample was 13.2%. • Regular use of sugar information on nutrition panels was associated with a significantly lower density of added sugar. • Persons who "always" used labels for sugar information consumed 1.1% less of their total energy from added sugars, compared with all other individuals ($P<0.05$).
Satia et al, 2005[91]	Observational, cross-sectional	N=658 blacks age 20-70 y	Not reported	Self-reported data from a population-based cross-sectional survey. An 11-page questionnaire assessed nutrition label use, fruit and vegetable consumption, total and saturated fat intakes, fat-related dietary behaviors, diet-related psychosocial factors, and demographic and behavioral characteristics. Mean age was 44±12 y, 41% were men, 37% were college	• 78% of respondents read nutrition labels when they purchased packaged foods. • Nutrition label use was significantly higher among participants who were women, older, educated beyond high school, and obese ($P<0.05$). • After adjusting for demographic characteristics, the strongest psychosocial predictors of nutrition label use were healthful eating self-efficacy, strong belief in a diet-cancer relationship, and

				graduates, and 75% were overweight/obese.	trying to lose weight. • Respondents who used labels usually/often had higher consumption of fruits and vegetables (mean 3.0 vs 2.1 servings per day, $P<0.0001$). • Respondents who usually/often read grams of fat information had lower total fat intake compared with those who rarely/never read this information (mean 29.1 vs 34.8 g/d, $P<0.0001$).
Lewis et al, 2009[92]	Observational, cross-sectional	N=5603 US adults age 18+ y in the NHANES survey	2005-2006	A survey was conducted to examine use of label information among persons with and without chronic disease. Participants were classified into 5 disease categories: hypertension, hypercholesterolemia, diabetes/at risk of diabetes, overweight, and heart disease. Data were collected via 17 questions about awareness of federal nutrition information and food label use. Two 24-h dietary recall interviews also were given.	• Subjects with chronic diseases were more aware of nutritional recommendations, checked more often for specific nutrients, and used nutrition information on food labels more often than did participants without such diseases. • However, label behavior use was inconsistently associated with dietary guideline compliance. Therefore, people with chronic disease generally reported better nutrition awareness than those without, but this did not translate into better eating behaviors.
Grimes et al, 2009[90]	Observational, cross-sectional	N=474 subjects surveyed in shopping centers within metropolitan Melbourne, Australia; 65% were female; 64% were the family's main shopper	Survey instrument to assess consumers' salt knowledge	Current labeling regulations in Australia require food products to display the sodium content of the food per serving and per 100 g within the nutrition information panel. Salt content is not provided (Sanz, 2007a) and many consumers may lack the knowledge to convert sodium into salt levels to accurately interpret sodium information. This study examined consumers' ability to interpret nutrition information about salt labeled on food products. Researchers approached passing shoppers and invited them to take part in the study by completing a questionnaire.	• 88% of participants knew of the relation between salt intake and high blood pressure. • 65% of participants were unable to correctly identify the relation between salt and sodium. • 69% reported reading the sodium content of food products when shopping. Sodium label use was significantly related to shoppers' concern about the amount of salt in their diet and the belief that their health could improve by lowering their salt intake. • ≈50% of shoppers were unable to accurately use labeled sodium information to select low-salt options.
Post et al, 2010[94]	Observational, cross-sectional	N=3748 US adults age 20+ y and with chronic disease in the NHANES survey	2005-2006	The purpose of this study was to assess whether patients with chronic disease who were advised by a healthcare professional to change their diet read nutrition labels and did so more frequently than patients who have not been so advised and whether these patients have a more healthful diet. Data were collected using both survey questions and 24-h dietary recall data.	• Among patients with chronic disease, the odds of reading food labels when told by their doctor or another healthcare professional to reduce calories or weight was 50% higher than in those without physician intervention (OR=1.50; 95% CI, 1.12-2.00). • Those who read food labels consumed lower daily energy (2058 vs 2251 kcal; $P=0.006$), saturated fat (26.8 vs 29.2 g; $P=0.04$), carbohydrates (240 vs 267 g; $P=0.003$), and sugars (105 vs 126 g; $P=0.001$), and more fiber (16 vs 14.5 g; $P=0.01$) than those who did not.

Ollberding et al, 2010[87]	Observational, cross-sectional	N=4454 US adults age 18+ y in the NHANES survey	2005-2006	The purpose of this study was to describe the prevalence of food label use and the association between food label use and nutrient intake. Data on food label use were collected during the interview portion of the survey and nutrient intake was estimated using 2 24-h food recalls.	• 61.6% of participants reported using the Nutrition Facts panel. • 51.6% looked at the list of ingredients, 47.2% looked at serving size, and 43.8% reviewed health claims at least sometimes when deciding to purchase a food product. • There were significant differences ($P<0.05$) in food label use across all demographic characteristics examined. • When comparing food label users with nonusers, label users reported significant differences in mean nutrient intake of total energy (−164 kcal/d), total fat (−9 g/d), saturated fat (−3 g/d), cholesterol (−29 mg/d), sodium (−204 mg/d), dietary fiber (+1.1 g/d), and sugars (−12 g/d) ($P<0.05$ for each).
Vyth et al, 2010[104]	Observational, cross-sectional	N=404 adult shoppers in 9 Dutch supermarkets over 3 wk	Not reported	Shoppers completed a validated questionnaire asking about different motivations for food choice. These motivations were related to their purchased products, which were recorded and scored for a front-of-pack Choices logo after they had finished shopping.	• 62% of shoppers reported familiarity with the front-of-pack logo. • Attention to "weight control" and "product information" were the motivations for food choice that were positively associated with purchasing products with the logo. • The food choice motive "hedonism" was negatively associated with purchasing products with the logo.
Grunert et al, 2010[102]	Observational, cross-sectional	N=11,700 shoppers at major retailers in the United Kingdom (n = 2019), Sweden (n = 1858), France (n = 2337), Germany (n = 1963), Poland (n = 1800), and Hungary (n = 1804)	February 2008–February 2009	In-store observations and in-store interviews were conducted to evaluate the use of nutrition information on food labels and the understanding of GDA front-of-pack nutrition labels. Shoppers were also given questionnaires to complete at home (N=6000; response rate 50.3%). Use of labels was assessed in 6 product categories. Understanding of GDA front-of-pack nutrition labels was assessed by tasks related to conceptual understanding, substantial understanding, and health inferences. Demographics, nutrition knowledge, and interest in healthy eating were measured as potential determinants.	• Overall, 16.8% of shoppers looked for nutrition information. The main sources looked at were the nutrition facts, GDA labels, and ingredients lists. The main data sought were calories, fat, and sugar. • Understanding of GDA labels was high in the United Kingdom, Sweden, and Germany, and more limited in the other countries. • In regression analysis, country, interest in healthy eating, interest in nutrition knowledge, and social grade were associated with use and understanding.

Kristal et al, 2001[88]	Observational, longitudinal cohort	N=336 men and 502 women	Baseline data were collected from October 1995 to May 1996. Follow-up surveys were conducted from October 1997 to May 1998.	This prospective population-based study examined the demographic and psychosocial predictors of adopting reduced-fat and high fruit and vegetable consumption dietary patterns over 2 y. Data came from the Washington State Cancer Risk Behavior Survey, a random-digit-dial survey of adults age 18+ y to monitor attitudes and behavior related to cancer risk and prevention.	• During the 2 y of follow-up, fat intake (% energy) decreased by ≈2 percentage points and fruit and vegetable intake increased by 0.17 servings per day (P<0.001 each). • Changes were greater among women and persons who were well educated. • Persons in the maintenance stage of change and persons who believed there was a strong relation between diet and cancer made the largest dietary changes. • Use of food labels was strongly associated with reduction of fat but not with increases in consumption of fruits and vegetables.
Interventional Studies of Consumer Behavior					
Author, y	**Design**	**Population**	**Duration**	**Intervention/Evaluation**	**Major Findings**
Sacks et al, 2009[105]	Quasi-experimental comparison (pre- vs postintervention)	Shoppers at a major UK retailer thought to be representative of the UK population	4 wk before vs 4 wk after introduction of front-of-pack labeling in 2006	In 2006, the UK Food Standards Agency recommended that UK food retailers and manufacturers place front-of-pack traffic light labels on products in a range of categories. The format consisted of 4 separate color-coded lights indicating amount of fat, saturated fat, sugar, and salt. Red indicated a high level; amber, medium level; and green, low level. This study aimed to examine the impact of labeling on food sales in a major UK supermarket. Products were analyzed in 2 major categories: chilled prepackaged "ready meals" and fresh prepackaged "sandwiches." Data were collected as percent change in sales before vs after the traffic-light labels were introduced. Product promotions, life cycle, and seasonality were taken into account.	• Sales of ready meals increased by 2.4% in the 4 wk after the traffic-light labels were introduced. • Sales of the selected sandwiches did not change significantly. • For both types of foods, there was no association between label coding for healthfulness and changes in product sales.
Sutherland et al, 2010[106]	Quasi-experimental comparison (pre- vs postintervention)	Supermarket shoppers in Maine, New Hampshire, Vermont, Massachusetts, and northern New York	2 y Purchasing data obtained from 2006 to 2008 from a northeastern supermarket chain with 168 stores	The Guiding Stars Nutrition Navigation Program was implemented in September 2006. The program was driven by an algorithm that generates weighted scores based on points debited for *trans* fat, saturated fat, cholesterol, sodium, and added sugars and credited for vitamins and minerals, fiber, and whole grains. If a product met inclusion criteria for earning 1, 2, or 3 stars, the star icons	• Significant changes were seen in food purchasing immediately after implementation of the program and 1 and 2 y later. • Evaluating the same 8-mo period (January–August) each year, in 2006, 24.5% of items purchased earned a star rating; this proportion increased to 25.0% (P<0.001) and 25.9% (P<0.0001) at the 1- and 2-y follow-up periods, respectively.

				were displayed at the point of purchase on the UPC shelf tag. Purchasing data were examined before implementation and at 1- and 2-y follow-up periods.	• Evaluating a 4-wk period 1 y after program implementation, consumers purchased significantly more ready-to-eat cereals with stars (eg, less added sugars and more dietary fiber) and fewer no-star, high-sugar, low-fiber cereals.
Borgmeier and Westenhoefer, 2009[108]	RCT, short-term (1 session)	N=420 adults living in Hamburg, Germany	1-time exposure to 5 different experimental conditions	This study investigated which food label format enables consumers to best differentiate healthier products from less healthy ones and the impact of these food labels on planned food choices and diet quality. Five labels were evaluated: (1) a simple "healthy choice" tick, (2) a multiple traffic-light label, (3) a monochrome GDA label, (4) a color GDA label, and (5) no label. Data were collected on whether the labels influenced (1) subjects' ability to identify the healthier food item in 28 pairwise comparisons of foods from different food groups and (2) subjects' choice of foods from a range of different foods to compose a theoretical 1-d consumption.	Task I • Compared with no label, subjects could best identify the healthier food in pairwise comparisons with use of the traffic-light label, followed by either of the GDA labels and then the tick label ($P<0.001$ across comparisons). • Compared with no label, subjects' selections of a 1-d menu did not vary significantly according to any of the types of labels in terms of energy or nutrients.
Temple et al, 2010[107]	RCT, short-term (1 meal)	N=47 (24 male, 23 female) adults age 18-50 y recruited from flyers posted around the University of Buffalo	1 lunch session	Participants visited the lab for 1 session lasting ≈1 h. Participants were randomly assigned to 1 of 2 video groups (nutrition labeling education vs control [organic food movement]) and 1 of 2 labeling conditions (labels vs no labels). Participants watched a short educational video and then ate a buffet lunch.	Subjects assigned to nutrition label groups consumed less energy ($P<0.05$): • Women in the label group consumed 500 kcal vs 700 kcal for those in the no-label group. • Men in the label group consumed 600 kcal vs 1000 kcal for those in the no-label group. • The educational video had no independent effects.
Fiske and Cullen, 2004[109]	RCT (4 wk)	10 vending machines in teachers' lounges in Texas elementary and middle schools	• Assessed items sold • Assessed dollar sales for items • Total machine revenue	2-wk baseline assessment, 4-wk intervention • Each vending machine had 28 snack items and 5 choices of gum. • Low-fat items were promoted by means of – No intervention (control, 2 machines) – Increased availability plus labels (intervention I, 4 machines). – Increased availability plus labels plus signs (intervention II, 4 machines).	• The mean numbers of low-fat snacks sold were 2.5, 2.6, and 3.2 in the control, intervention I, and intervention II groups, respectively, but these differences did not achieve statistical significance ($P=0.08$). • A significant difference in total machine revenue was not seen with either intervention.

Vyth et al, 2011[110]	RCT (3 wk)	N=25 worksite cafeterias (13 intervention, 12 control) in the Netherlands	• Sales data were collected daily pre- and postintervention for 9 wk, from March to May 2009 • Employees (N=368) from 1 intervention and 1 control worksite completed questionnaires pre- and postinterventio n.	• Intervention cafeterias: Choices nutrition logo added to foods • Control cafeterias: same menu without the logo	• No significant intervention effects were found in sales of sandwiches, soups, snacks, fruit, or salads. • Self-reported "intention to eat healthier" and "paying attention to product information" were positively associated with self-reported consumption of foods with the Choices logo at lunch.
Combined Interventions					
French et al, 2001[111]	RCT	55 vending machines in 12 secondary schools and 12 worksites in Minnesota	1 y	Changing Individuals' Purchase of Snacks (CHIPS) study • 55 vending machines were used, including placement of low-fat snacks in 2 designated rows of the machine. • Effects of price and labeling on sales were evaluated during a 1-y intervention. • Labeling conditions: none, low-fat label, low-fat label plus promotional sign • Pricing conditions: equal price, 10% reduction, 25% reduction, 50% reduction	• Labels alone had no effect on sales. • Promotional signage was associated with a very small increase in low-fat snack sales. • Price reductions of 10%, 25%, and 50% on low-fat snacks were associated with significant increases in low-fat snack sales. Low-fat snack sales increased by 9%, 39%, and 93% respectively.
Lowe et al, 2010[112]	Quasi-experimental (pre- vs postintervention)	N=96 hospital employees	Worksite cafeteria purchases at lunch assessed by scanned food purchasing cards, comparing the period 3 mo before vs after interventions	Group 1: environmental changes in the cafeteria, including addition of selected healthier options along with food labeling (calories, energy density, macronutrients) for all foods sold during lunch Group 2: environmental changes in the cafeteria plus pricing incentives and 4 1-h group sessions of nutrition education on strategies for decreasing energy density of the diet	• Comparing before vs after intervention in both groups, total lunchtime calories and percent energy from fat decreased (≈70 kcal and 5% energy less, respectively; $P<0.01$ each). • There were no differences between the 2 intervention groups, ie, the addition of pricing incentives and nutrition education did not appear to have any additional impact. However, the sample size was small and may have not been adequately powered after attrition of subjects.
Thorndike et al, 2011[113]	Quasi-experimental	Large hospital cafeteria in	Electronically recorded food	Foods and beverages were labeled with simple color codes (red, yellow, green)	• After 3 mo, sales of "red" products decreased by 9.2%, including 23.1% lower sales of sugar-

	(pre- vs postintervention)	Boston, Massachusetts, plus 2 smaller comparison cafeterias in the same hospital	sales in the 3 mo before vs after the labeling change	based on USDA food pyramid guidelines in the intervention cafeteria. No changes were made in the comparison cafeterias.	sweetened beverages. Sales of “green” products increased by 4.5% ($P<0.001$ each). • Total sales did not change. • No changes were seen in sales of these different foods at the 2 comparison cafeterias.

CSFII indicates Continuing Survey of Food Intakes by Individuals; DHKS, Diet and Health Knowledge Survey; NHANES, National Health and Nutrition Examination Survey; OR, odds ratio; CI, confidence interval; GDA, guideline daily amount; UPC, universal product code; and RCT, randomized controlled trial.

Note: Reference numbers (eg, Neuhouser et al, 1999[83]) appearing in this supplementary table correspond with those listed in the reference section of the statement. For the purposes of this supplementary table, these meta-analyses or systematic reviews (see "Author, y" column) are considered the primary citation. Additional studies mentioned in the primary citation may be included in the "Intervention/Exposure" and "Findings" columns. The additional studies can be accessed through the primary citation.

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