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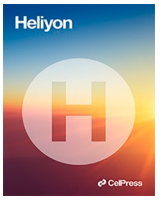

Research article

Potential consumer response to the healthy symbol proposed by the U.S. food and Drug Administration

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ABSTRACT

The U.S. Food and Drug Administration (FDA) has proposed updates to the definition of "healthy," including distinctions between types of sugar and fats and limits on added sugar, saturated fat, and sodium. To communicate the updated standards, the FDA is developing a Healthy symbol to display on food packages, which could reduce knowledge gaps by assisting U.S. consumers in meeting recommended nutritional guidelines. This study aimed to explore the potential for the label to increase consumers' ability to correctly identify a food product that met the FDA's criteria for a healthy symbol. To complete the study objective, 1018 adults were recruited to represent the U.S. population regarding gender, age, income, and geographic region, and a randomized group experiment was used to determine the potential communication value of an FDA Healthy symbol. Respondents were randomized to a group shown either a healthy yogurt with the FDA symbol, a healthy yogurt without the symbol, or an unhealthy yogurt. Respondents were then asked whether they considered the yogurt shown to be healthy, a question examining the desired criteria for the Healthy symbol, willingness to accept various costs to implement the symbol, and questions to measure objective dietary knowledge. Adding the symbol to yogurt that already met the healthy criteria only yielded about a 4 percentage point increase in the proportion of respondents identifying it as healthy. However, 53 % of participants still identified a yogurt too high in added sugars as healthy. For the desired label criteria, 64 % of respondents selected limits on added sugars, 57 % selected limits on sodium, and 54 % selected limits on saturated fats, which all align with the proposed updates to the definition of healthy. Over half of the participants supported the implementation of the label, even at a cost of $40 annually, and 86 % supported implementation at no cost.

1. Introduction

In September of 2022, the United States (U.S.) Food and Drug Administration (FDA) proposed a rule to update the definition of "healthy" claims for food contents [1]. The original healthy definition was established in 1994 [2], and the goal of the proposed rule is to better align the definition with current scientific knowledge and dietary recommendations like those in the *Dietary Guidelines for Americans, 2020–2025* [3]. For example, current knowledge about fatty acids has prompted dietary recommendations to shift away from limiting total fat and instead target saturated fat. Moreover, the FDA recently updated the Nutrition Facts Label, found on the

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back of packages of food products, to provide distinctions between added and natural sugars [4]. There is evidence that some consumers want access to information about added sugars [5], and that providing the information increases attention to the sugar content of products [6,7].

Dietary challenges for U.S. citizens include the underconsumption of certain food groups and the overconsumption of certain nutrients. The FDA estimates that 75 % of U.S. citizens consumed less than the recommended intake of vegetables, fruits, and dairy, 63 % consumed more than the recommended level of added sugars, 77 % consumed more than the recommended level of saturated fat, and 90 % exceeded the Chronic Disease Risk Reduction limits for sodium [8]. These are motivating factors for updating the definition of healthy claims, and the proposed changes seek to simultaneously require a product to contain a minimum amount of at least one food group (e.g., fruit) and a maximum amount of added sugar, saturated fat, and sodium. Minimums are based on "food group equivalents," and limits for nutrients are based on proportions of daily value recommendations. Without simultaneously communicating nutrients to be encouraged and limited, nutrition claims can potentially mislead consumers about the overall healthfulness of a product [9].

In addition to updating the definition of healthy, the FDA has also requested quantitative research for a "Healthy" symbol that could voluntarily be displayed on packaged foods as a front-of-package (FOP) label [10]. Research shows that although consumers tend to report using nutrition information found on the back of packages, label use is low when actual purchasing decisions are made [11]. Thus, the FDA-certified Healthy symbol could guide consumers to make more informed dietary choices when contemplating the many options at food retailers. Many FOP labels have been developed and tested worldwide [12]; for example, symbols in Chile warning that food was high in specific nutrients (e.g., sodium), Nutri-Score in France, and the Health Star rating in Australia and New Zealand [13].

Generally, FOP labels can be separated into three categories: non-directive, diet-directive, or food-directive [14]. Non-directive labels provide only a description of the nutritional contents of a product. In contrast, diet-directive labels indicate whether product nutrients are greater or less than recommended values (e.g., by overlaying colors on nutrient values), and food-directive labels indicate whether a product is considered nutritious without providing specific nutrient values. The Healthy symbol proposed by the FDA would be classified as a food-directive label because it affirms that a food product is nutritious [15]. FOP labels can garner relatively more consumer attention than standard nutrition information; however, implementation of new labels benefits from education and awareness campaigns because attention is associated with label familiarity [16]. There is evidence that FOP labels can increase the selection of products with improved nutrition profiles, but data on consumption outcomes are sparse [17,18].

This study aimed to assess potential consumer response to the FDA's recently proposed Healthy symbol. Specifically, we examine 1) how the presence of a FDA Healthy symbol impacts consumers' identification of a healthy product; 2) U.S. consumer preferences for which factors should be required for a food to carry the FDA Healthy symbol (e.g., limits on added sugars); and 3) demand for the FDA healthy-labeling policy at different implementation costs to consumers. Though it is unlikely that consumers would bear any costs associated with the implementation of this label, the referendum question is included to further gauge consumer demand for the label, as it is expected that respondents would widely support any additional front-of-package information at zero cost. Consumers were also asked about the recommended intake levels for the food groups and nutrients of interest motivating the proposed changes to the definition of healthy by the FDA, which were used as an objective measure of dietary knowledge to determine variation in the potential communication value of the FDA Healthy symbol for consumers who may benefit most from a symbol affirming that a food product is nutritious.

2. Methods

This study was conducted according to the guidelines established in the Declaration of Helsinki, and all procedures involving research study participants were approved by the Institutional Review Board at the ≪*masked for review*>> (IRB #22965). Written informed consent was obtained from all subjects at the beginning of the online survey.

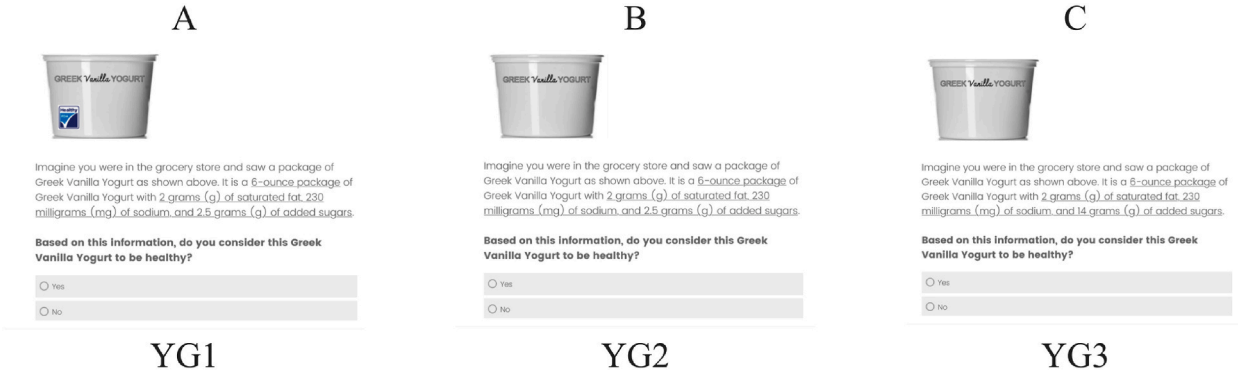

Fig. 1. The questions displayed to the yogurt groups. The question shown to Yogurt Group 1 (YG1) is shown in panel A, the question shown to Yogurt Group 2 (YG2) is shown in panel B, and the question shown to Yogurt Group 3 (YG3) is shown in panel C.

2.1. Survey and experimental designs

The online survey consisted of multiple components to assess consumer response to the FDA's proposed Healthy symbol. The first component employed an experiment that randomized participants to one of three groups to determine how the presence of a FDA Healthy symbol impacts consumers' identification of healthy products. Participants were shown a six-ounce cup of Greek Vanilla yogurt and asked if they considered it healthy. More specifically, we asked: "*Imagine you were in the grocery store and saw a package of Greek Vanilla Yogurt as shown above. It is a 6-ounce package of Greek Vanilla Yogurt with <X> grams (g) of saturated fat, <Y> milligrams (mg) of sodium, and <Z> grams (g) of added sugars. Based on this information, do you consider this Greek Vanilla Yogurt to be healthy?*" Response options were "Yes" or "No." Greek Vanilla yogurt was selected for this experiment because it was used as a sample food on the FDA website when discussing the proposed rule to update the definition of healthy (a screenshot from the FDA website is shown in Supplementary Material Fig. 1). Yogurt group 1 (YG1) was shown a cup displaying a FDA Healthy symbol and given nutrition information for saturated fat (2.5 g), sodium (230 mg), and added sugars (2.5 g), which are within the FDA limits for this yogurt to be considered healthy. Yogurt group 2 (YG2) was shown a cup with the same nutrition information as YG1; however, the cup did not carry a FDA Healthy symbol. Yogurt group 3 (YG3) was shown a cup that exceeded the added sugar limit (14 g) and did not carry the FDA Healthy symbol; 14 g of added sugars was selected because it is the amount in a major brand of yogurt sold in stores. The questions displayed to the three yogurt groups are shown in Fig. 1. There were 337 participants randomized to YG1, 345 to YG2, and 336 to YG3.

In the second survey component, all participants were asked what factors should be required for food to carry the FDA Healthy symbol. The factors provided to participants included both maximum and minimum amounts of nutrients to reflect the goals of the proposed update to the definition of healthy. The 'limits on' factors provided as response options were: added sugars, natural sugars, saturated fats, unsaturated fats, sodium, calories, and serving size. The 'high in' factors provided as response options were: fiber, protein, and vitamins. An "other" option was also offered as a response option in case the research team did not provide a factor relevant to participants. This question had a select-all response format, so participants could select any factors they thought should be required.

The third component of the survey employed another experiment that randomized participants to one of three referendum groups to determine consumer demand for the FDA Healthy symbol. Participants were asked whether they would vote to implement the Healthy symbol if an increase in annual federal taxes accompanied it. The specific wording of the referendum was as follows: "*Suppose the next time you went to vote, there was a referendum on the ballot to add a new label to identify healthy foods in the grocery store. To be labeled healthy, the Food and Drug Administration (FDA) has proposed that a product would need to contain a certain meaningful amount of food from at least one of the food groups or subgroups recommended by the Dietary Guidelines (for example, fruit, vegetable, dairy, etc.). The product would also have to limit certain nutrients such as saturated fat, sodium, and added sugars to be healthy. If passed, the policy is expected to cost your household $<X>. How would you vote on the referendum if your annual federal taxes would increase by $<X> if the ballot*

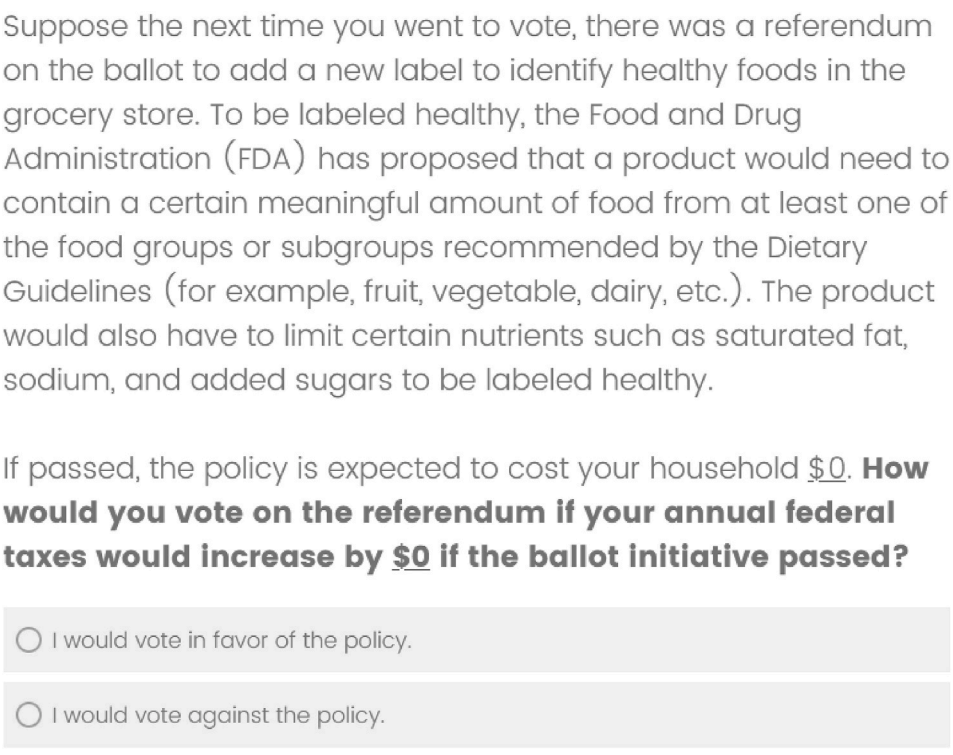

Fig. 2. The question displayed to the referendum group with an annual tax cost of $0 (RG1).

initiative passed?" Response options were "I would vote in favor of the policy" or "I would vote against the policy." Referendum group 1 (RG1) was shown a tax increase of $0, referendum group 2 (RG2) was shown a tax increase of $20, and referendum group 3 (RG3) was shown a tax increase of $40. While it is highly unlikely that implementing the symbol would increase annual taxes by a noticeable amount, increasing yearly taxes by $20 increments across the groups provides information about the sensitivity of consumer demand to implementation costs and whether the sensitivity is linear or nonlinear. The referendum question shown to RG1 is provided in Fig. 2 as an example.

Lastly, participants were asked about the consumption levels recommended by experts for a person on a diet of 2000 calories per day. Questions for food groups with a minimum recommended consumption level were vegetables, fruits, grains, dairy, and protein. In contrast, questions for nutrients with a maximum recommended consumption level were added sugar, saturated fat, and sodium. These questions were asked to identify the participants who needed to gain knowledge about the minimum and maximum consumption levels recommended by experts.

2.2. Data analysis

Data from the yogurt experiment allowed us to determine the potential communication value of the FDA Healthy symbol by comparing the proportion of participants who considered the cup of yogurt to be healthy across the three groups. The yogurts shown to YG1 and YG2 had the same nutrition profile, but the yogurt shown to YG1 also displayed a FDA Healthy symbol. Therefore, comparing the proportion of participants that considered a yogurt healthy across these two groups (i.e., $P_{YG1} = P_{YG2}$) determines whether a symbol is needed to communicate that a product is within the proposed FDA limits. YG3 was shown a yogurt with an amount of added sugar higher than the FDA healthy limit, so participants in this group considering the yogurt to be healthy provided some indication about the level of consumers unable to identify a healthy level of added sugar as proposed by the FDA. The proportion of participants considering the yogurt to be healthy in YG3 was compared with the other symbol groups ($P_{YG3} = P_{YG1}$ and $P_{YG3} = P_{YG2}$) to examine further the impact of the FDA Healthy symbol and whether consumers are generally able to determine what is healthy.

The ranking of factors consumers thought should be required for food to carry the FDA Healthy symbol was determined by comparing predictive margins estimated from a binary logistic regression model. Estimated predictive margins match the proportions that participants selected factors and allow for simultaneous pairwise comparisons using Bonferroni-adjusted *p*-values that account for the multiple comparisons between factors. The pairwise comparisons provide groupings (ranking) of factors at a *p*-value less than 0.05. To estimate the binary logistic regression model, the data were expanded so that there were 11 rows per participant because participants could select more than one factor. Then, a single dependent variable was created and set equal to one if a factor was selected, or zero if the factor was not selected. The binary logistic regression model estimated can be generally specified by Equation (1):

$$\Pr(F_{in} = 1) = \alpha_i, \tag{1}$$

where F_{in} is equal to one if the *i*th factor was selected by participant *n* and zero otherwise, and α_i is a vector of specific constants estimated for the *i*th factor. Standard errors were clustered by participant when estimating the model to account for expanding the data from one row to 11 rows for each participant.

Data for the referendum groups were analyzed like the data from the yogurt groups, where differences in group proportions were estimated ($P_{RG1} = P_{RG2} = P_{RG3}$). RG1 was asked if they supported implementing the FDA Healthy symbol at an annual tax increase of $0; thus, it is expected that RG1 will have the highest support. The proportions of participants supporting the FDA Healthy symbol in the other groups indicate sensitivity in consumer demand to implementation costs, as RG2 and RG3 were shown an annual tax increase of $20 and $40, respectively. The data from the referendum groups and participants in YG1 were also examined using tests of proportions to determine whether those in support of the FDA Healthy symbol also considered the yogurt carrying the symbol to be healthy. We hypothesized that the FDA Healthy symbol would have greater efficacy for participants who voted in favor of implementing the symbol.

Data from the recommended consumption level questions were used to measure objective knowledge about nutrition. Responses above the recommended maximum for a nutrient with a limit or below the recommended minimum for a food group were coded as a one, and zero otherwise. These indicator variables were used as independent variables in binary logistic regression models, with responses from the yogurt experiment used as dependent variables equal to one if a yogurt was considered healthy. Separate models were estimated for each yogurt group, given that participants were randomized to view only one cup of yogurt because participants were randomized to YG1, YG2, or YG3. Results from these models indicate whether the participants who lacked knowledge about the minimum and maximum consumption levels recommended by experts were more or less likely to consider the yogurt shown to be healthy than other participants. The binary logistic regression models estimated can be generally specified by Equation (2):

$$\Pr(YG_{gn} = 1) = \alpha_g + \beta_{g1} L\_Vegetable_n + \beta_{g2} L\_Fruit_n + \beta_{g3} L\_Grain_n + \beta_{g4} L\_Dairy_n + \beta_{g5} L\_Protein_n + \beta_{g6} H\_AddSugar_n + \beta_{g7} H\_SatFat_n + \beta_{g8} H\_Sodium_n, \tag{2}$$

where YG_{gn} is equal to one if participant *n* in yogurt group *g* considered the cup of yogurt to be healthy and zero otherwise, all independent variables beginning with '*L_*' are equal to one if participant *n* selected an amount below the recommended level for a food group, all independent variables beginning with '*H_*' are equal to one if participant *n* selected an amount above the recommended level for a nutrient, α_g is an estimated constant term, and the β's are estimated coefficients that determine whether participants lacking

knowledge were more or less likely to consider yogurt *g* to be healthy.

2.3. Participant recruitment

For this study, 1018 participants were recruited and compensated by Qualtrics to complete an online survey about food and agricultural policy issues. The survey was fielded in November of 2022. Two participants did not answer a referendum question, so the sample size was reduced to 1016 for referendum group analysis. A quota sampling approach was used so that the sample matched the U.S. population in terms of gender, age, income, and geographic region. Summary statistics for participant characteristics are presented in Supplementary Materials Table 1 for all participants sampled and across the experimental groups. Multivariate analysis of variance (MANOVA) models were estimated for the yogurt groups and referendum groups to determine if there was overall variation in respondent characteristics across the experimental groups; there was not an overall difference across the yogurt groups (Roy's largest root, p-value = 0.60) or the referendum groups (Roy's largest root, p-value = 0.26).

3. Results

3.1. Potential Communicative Value of the FDA healthy symbol

Fig. 3 illustrates group responses from the yogurt experiment. The cups of Greek Vanilla Yogurt shown to YG1 were considered healthy by 66 % of participants (95 % CI: 61 %, 71 %), 62 % in YG2 (95 % CI: 57 %, 67 %), and 53 % in YG3 (95 % CI: 48 %, 59 %). The yogurt with a FDA Healthy symbol was considered healthy by the highest proportion of participants. However, the proportion of participants considering the cup of yogurt healthy in YG1 was not statistically significantly different from the 62 % of participants in YG2 who were shown the same nutrition profile without a symbol (p-value = 0.38). Thus, the FDA Healthy symbol may not provide additional communication value for foods within the guidelines of the proposed updates to the healthy definition. However, it should be noted that because of the sample sizes for YG1 (n = 337) and YG2 (n = 345), the difference in proportions that the yogurts were considered healthy would need to be about 10 % to detect statistical significance at an alpha equal to 0.05 (Type I error) and a beta equal to 0.20 (Type II error).

The cup of yogurt with 14 g of added sugars, which is more than five times the amount of added sugar to be defined as healthy by the proposed update, was considered healthy by 53 % of the participants in YG3. Although, the 53 % in YG3 was statistically different than the 66 % in YG1 (p-value$<$0.01) and 62 % in YG2 (p-value = 0.02). Due to the randomized design of the yogurt experiment, it is unclear whether fewer participants in YG3 would have considered the yogurt high in added sugar healthy if an option displaying the FDA Healthy symbol was also available at food retailers. Nevertheless, more than 30 % of participants in YG1 did not consider the yogurt with a FDA Healthy symbol to be healthy.

3.2. Consumer preferences for factors to be required to carry the FDA healthy symbol

Table 1 shows the predictive margins and groupings of margins for factors that participants thought should be required for food to carry the FDA Healthy symbol. Recall that this question had a select-all response format, and the predictive margins are equivalent to the proportion of respondents that selected a factor. Three factors were selected by more than half of the participants, and all three factors were associated with limits on nutrients. Limiting added sugars was selected by 64 % of participants, limiting sodium was selected by 57 %, and limiting saturated fats was selected by 54 % of participants. Information about limiting added sugar ranked significantly higher than the other factors, followed by limits on sodium and saturated fats ranked as the second highest. While high in protein and high in fiber were selected by similar proportions of participants, U.S. diets are more critically deficient in fiber than protein. The *Dietary Guidelines for Americans 2020–2025* notes that over 90 % of consumers do not meet the recommended daily fiber intake, which is related to the general underconsumption of fruits, vegetables, and whole grains, but protein intakes are close to the

Table 1
The predictive margins for the selections of factors that should be required for a food product to carry the FDA Healthy symbol.

Factors	Predictive Margins	Groupings of Predictive Margins
Limits on added sugars	0.64	A
Limits on sodium	0.57	B
Limits on saturated fats	0.54	B
Limits on calories	0.41	C
High in protein	0.41	C
High in vitamins	0.39	C
Limits on unsaturated fats	0.36	C
High in fiber	0.35	CD
Limits on natural sugars	0.30	D
Limits on serving size	0.19	E
Other	0.05	F

Note: The predictive margins were estimated using a logistic regression model. Predictive margins for factors not sharing a letter are different using Bonferroni-adjusted p-values less than 0.05.

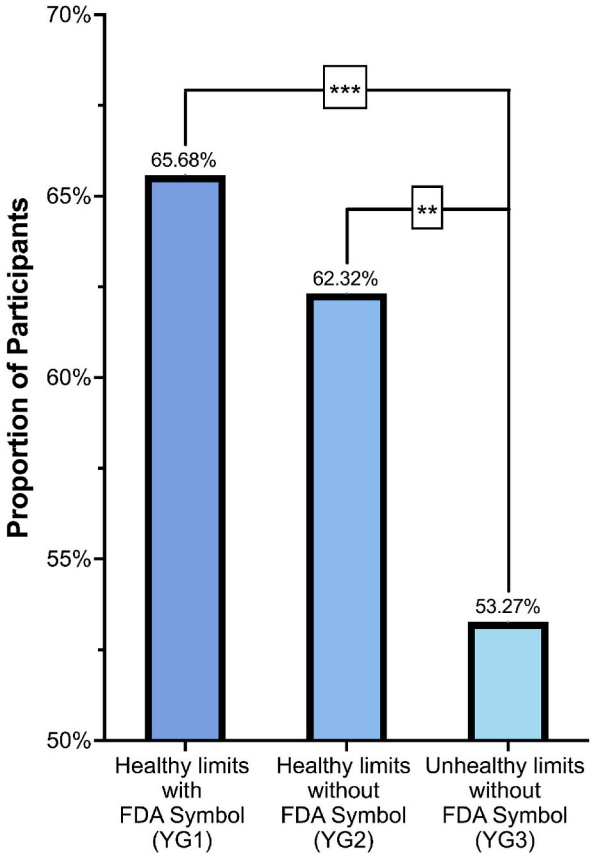

Fig. 3. The proportion of participants within a yogurt treatment considering the Greek Vanilla Yogurt shown to be healthy. Note: *** and ** denote significance at a *p*-value less than 0.01 and 0.05.

recommended amounts. Results in Table 1 also demonstrate that consumers can make important distinctions between nutrients. For example, saturated fat was selected significantly more than unsaturated fats, which aligns with the reframing of the Dietary Guidelines for Americans, which sets recommendations for only saturated fats instead of total fats and cholesterol. Also consistent with federal dietary recommendations, added sugar was selected at a significantly higher rate than natural sugars.

3.3. Demand for the FDA healthy symbol

Fig. 4 illustrates the proportion of participants in the referendum groups supporting the implementation of the FDA Healthy symbol. At an implementation cost of $0, 86 % of participants in RG1 supported the symbol. There was a significant reduction in support when a cost was assigned to implementing the policy. Approximately 29 % and 36 % fewer participants would be willing to accept an annual cost of $20 or $40, respectively, but still, more than half of the participants supported the policy at these cost levels. There was not a statistically significant difference in the level of support when the implementation cost increased from $20 to $40 ($p > 0.05$), which indicates that decreases in support due to implementation costs are likely nonlinear. Also, there were no statistically significant differences in the proportions of participants in YG1 who considered the yogurt with the FDA Healthy symbol to be healthy by the support of the referendum (*p*-values: $0=0.30, $20=0.88, and $40=0.12). Thus, the efficacy of the FDA Healthy symbol was not higher for those supporting the symbol.

3.4. Nutrition Knowledge and Potential Communicative Value of FDA Healthy Symbol.

Table 2 shows the proportions of responses to the recommended consumption level questions. Participants generally thought the recommended levels were lower than the actual dietary guidelines for vegetables, grains, and dairy, which is consistent with current consumption patterns. Though most U.S. citizens consume more sugar, saturated fat, and sodium than the recommended levels, participants also generally underestimated the recommended levels for these nutrients. The below-recommended selection for the nutrients to limit may indicate a potential misperception of absolute avoidance. It is possible that the FDA Healthy symbol can help fill in some of the knowledge gaps regarding the appropriate minimum and maximum consumption levels and help guide consumers towards healthier choices among product options.

Coefficients from the binary logistic regression models estimated to determine whether participants who lacked knowledge of recommended consumption levels were more or less likely to consider the yogurts to be healthy than other participants are shown in

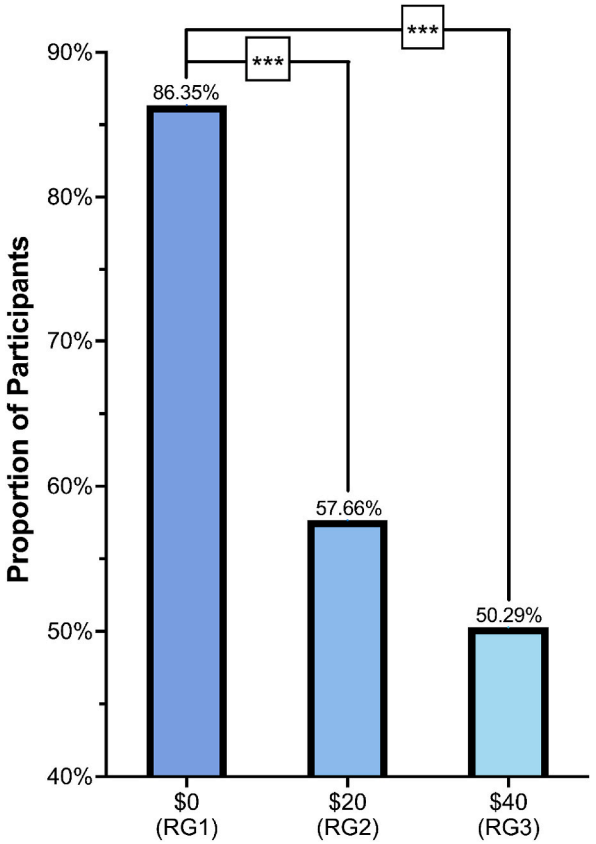

Fig. 4. The proportion of participants in a referendum supporting the implementation of a FDA Healthy symbol. Note: *** denotes significance at a *p*-value less than 0.01.

Table 2
Share of participants that selected consumption levels lower, equal to, or higher than recommended amounts for select food groups and nutrients.

	Vegetable	Fruit	Grain	Dairy	Protein	Added Sugar	Saturated Fat	Sodium
Lower than the recommended amount	57.66	32.61	52.65	86.35	42.44	46.07	37.52	67.78
The recommended amount	9.72	34.68	22.5	9.23	10.51	29.47	34.18	19.84
Higher than the recommended amount	32.61	32.71	24.85	4.42	47.05	24.46	28.29	12.38

Note: Vegetable, fruit, grain, dairy, and protein have recommended minimums. Added sugar, saturated fat, and sodium have recommended maximums.

Table 3. Participants in YG3 who overestimated the maximum amount of added sugar recommended by experts were more likely to consider the yogurt with an unhealthy level of added sugar to be healthy. Added sugar is the most relevant independent variable in this model because it was the only nutrient that varied from YG1 and YG2, and it is the nutrient with a level too high for the cup of yogurt to be considered healthy by the proposed FDA definition. The variable for overestimating added sugar was insignificant in the other models, indicating that consumers with low objective knowledge about added sugar limits could benefit from the FDA Healthy symbol. The FDA Healthy symbol could have significant communication effects if the symbol is salient for consumers with low objective knowledge, and if the symbol is displayed on some products near unhealthy products so that consumers may examine the relative nutrient difference(s) between products carrying the symbol and products not carrying the symbol.

4. Discussion

Food consumption trends of the average U.S. consumer, along with high frequencies of diet-related health complications and the resulting social costs, continue to warrant concern among nutritionists and policymakers. To improve dietary choices and thereby reduce the number of preventable deaths and diet-related chronic diseases in the U.S., the Food and Drug Administration (FDA) is establishing a “healthy” labeling initiative aimed at nudging food choices when consumers make purchasing decisions. The goal is to increase the consumption of fruits, vegetables, dairy, and whole grains while preventing overconsumption of saturated fat, sodium,

Table 3
Estimated coefficients for the association between particpants lacking knowledge about recommended levels and considering a yogurt to be healthy by experimental group.

	Healthy limits with FDA Symbol (YG1)	Healthy limits without FDA Symbol (YG2)	Unhealthy limits without FDA Symbol (YG3)
L_Vegetable	0.246	0.264	0.467
	(0.260)	(0.259)	(0.248)
L_Fruit	−0.175	−0.108	0.358
	(0.267)	(0.269)	(0.272)
L_Grain	0.088	0.081	0.425
	(0.254)	(0.243)	(0.245)
L_Dairy	−0.149	0.284	−0.583
	(0.341)	(0.329)	(0.377)
L_Protein	−0.121	0.035	0.166
	(0.249)	(0.243)	(0.250)
H_AddSugar	0.472	0.449	1.090**
	(0.346)	(0.306)	(0.318)
H_SatFat	0.451	0.056	0.222
	(0.311)	(0.275)	(0.297)
H_Sodium	−0.029	0.566	−0.170
	(0.358)	(0.477)	(0.387)
Constant	0.484	−0.078	−0.325
	(0.341)	(0.338)	(0.397)
Log likelihood	−212	−224	−214
Number of Observations	337	345	336

Note: Coeffients were estimated from binary logistic regressions models. Standard errors are reported in parentheses. *** denotes significance at a *p*-value less than 0.01.

and added sugars. Like various diet-related healthy labels used globally, implementing the proposed FDA Healthy symbol in the United States can potentially help guide consumers to more nutritious food choices, eventually reducing some of the medical and social costs associated with poor dietary health and obesity.

Several previous experiments have evaluated the effectiveness of various nutrition-related FOP labels, and there is variation across experiments in identifying which type of FOP is most impactful using different measurement indicators. Most studies that examine the effect of FOP labels use purchasing decisions as the dependent variable, while this experiment focuses on consumer perceptions of a product with or without the FDA Healthy label as a preliminary step before testing the label in a purchasing scenario. In terms of product choice, FOP labels that are simple and easy to understand, similar to the food directive FDA Healthy symbol used in this study, have been most influential in guiding healthier food purchases in some experiments [18,19]. However, other studies have found a more significant effect on purchasing behavior associated with interpretive labels like multicolor or traffic light schemes, though all labels that affirmed the healthfulness of a product (i.e. “positive” labels) were significantly different than the control [20]. A vending machine experiment evaluating FOP labels including green “choose often” (similar to the FDA Healthy symbol), single traffic light, physical activity calorie equivalent, and nutrition warning labels found that all included label varieties led to a similar reduction of calories in respondents’ chosen snacks or beverages, with no significant variation between respondents’ education levels [21].

Other studies have explored the effect of various FOP labels on the perceived healthfulness of food products, and the results are also somewhat inconsistent across experiments and types of labels. Generally, most studies analyzing healthfulness perceptions have found a significant positive effect associated with positive nutrition labels, but the effect of negative or warning labels is often more significant. For example, in studies using a Likert-scale rating system for the healthfulness of various products, positive nutrition claims such as “high in fiber” and “healthy ingredients” significantly increased respondents’ perceived healthfulness of healthy products, but the result was even more significant for the effect of warning labels decreasing the perceived healthfulness of unhealthy foods [22,23]. A web-based supermarket experiment using positive and negative labels including an FDA Healthy label, an Unhealthy label, a combination of both, and a control label showing total calories found that the positive Healthy label increased respondent’s ability to select the healthy choice from a pair of foods by about 5 %, and by 15 % when both positive and negative labels were used [24]. However, this result is not directly comparable to our study since respondents were prompted to select the healthier choice from a pair of foods rather than asking about the healthfulness of a single product. This result has also been contradicted by other work testing the combined effect of positive and negative labels, which found that showing both labels simultaneously on a product diluted the impact of the positive label on increasing purchases of labeled foods and total calories consumed [25].

Results from this survey show that consumers generally support the FDA Healthy symbol and agree that limits on added sugars, sodium, and saturated fats should be included in the healthy definition. When the label was implemented at no cost to participants, almost 9 in 10 supported implementation. However, a high level of support at no cost is expected because high demand rates have been estimated for other food labels when participants are simply asked if they support labeling. For example, 84 % of participants in another U.S. survey supported mandatory labeling for food containing deoxyribonucleic acid (DNA) [26]. Generally, consumers prefer to have the ability to access information, even if the accurate interpretation or use of that information in decision-making is unclear. It should also be noted that consumers are unlikely to be able to officially “vote” on the implementation of a Healthy symbol; however, it is instructive to understand whether there is demand for this information on food packages.

The FDA Healthy symbol did not dramatically increase the ability of consumers to identify that a cup of yogurt was healthy with the

same nutrition profile; however, the difference in proportions would need to be at least 10 percentage points to detect a statistically significant difference given the sample sizes. More than half of consumers considered a cup of yogurt high in added sugar to be healthy. These results suggest that the FDA Healthy symbol may be more impactful in informing consumers that some foods are *not* as healthy as perceived. However, a limitation of this study is a lack of a side-by-side comparison between healthy and unhealthy yogurts to determine the relative impact of the FDA Healthy symbol. The ability of the FDA Healthy symbol to steer consumers away from unhealthy options could be valuable, particularly given that consumers lacking knowledge about added sugar limits in our sample were more likely to consider the yogurt high in added sugar as healthy. Another possible limitation is how the nutritional information was shown to respondents, as it is unclear whether showing participants the Nutrition Facts Panel would change results.

It should also be noted that over 30 % of consumers did not identify a yogurt as healthy even when it displayed the FDA Healthy symbol. Future research should examine the potential reasons for this, as this study only examined one food product and this result may vary across products. However, this result could also be related to a lack of familiarity with the label or skepticism toward the label. Mitra et al. found that consumers trust food labels more than food advertisements; however, consumers exhibited more skepticism toward health claims than the Nutrition Facts Panel [27]. While the proposed FDA Healthy symbol is food-directive and designed to summarize and provide an evaluation of some nutrients from the Nutrition Facts Panel, it may take time for consumers to make this connection. As such, education efforts will be critical in making this symbol a useful tool for consumers in their decision-making processes.

Overall, results from this survey provide evidence for the potential of the proposed FDA Healthy symbol to address various dietary knowledge gaps among U.S. consumers by providing an easily identifiable indicator of a food product choice that meets recommended nutritional guidelines. Also, implementing the FDA Healthy symbol may eventually impact the availability of healthy food product choices at food retailers. Changes could spur food manufacturers to reformulate the ingredients in products, which has occurred from food labeling requirements like that for *trans*-fatty acids [28].

Data availability statement

The data and code (i.e., Stata 17 SE) used for data analysis is available at: https://osf.io/4b93k/?view_only=89c8a84455cd4419a5e286b16a0d7f8a.

Ethical standards disclosure

This study was conducted according to the guidelines established in the Declaration of Helsinki, and all procedures involving research study participants were approved by the Institutional Review Board at the University of Illinois (IRB #22965). Written informed consent was obtained from all subjects at the beginning of the online survey.

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CRediT authorship contribution statement

Jillian Hyink: Writing – original draft, Formal analysis. **Brandon McFadden:** Writing – review & editing, Formal analysis, Conceptualization. **Brenna Ellison:** Writing – review & editing, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e30863.

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