Evaluating the Impact of Menu Labeling on Food Choices and Intake

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Objectives. We assessed the impact of restaurant menu calorie labels on food choices and intake.

Methods. Participants in a study dinner (n=303) were randomly assigned to either (1) a menu without calorie labels (no calorie labels), (2) a menu with calorie labels (calorie labels), or (3) a menu with calorie labels and a label stating the recommended daily caloric intake for an average adult (calorie labels plus information). Food choices and intake during and after the study dinner were measured.

Results. Participants in both calorie label conditions ordered fewer calories than those in the no calorie labels condition. When calorie label conditions were combined, that group consumed 14% fewer calories than the no calorie labels group. Individuals in the calorie labels condition consumed more calories after the study dinner than those in both other conditions. When calories consumed during and after the study dinner were combined, participants in the calorie labels plus information group consumed an average of 250 fewer calories than those in the other groups.

Conclusions. Calorie labels on restaurant menus impacted food choices and intake; adding a recommended daily caloric requirement label increased this effect, suggesting menu label legislation should require such a label. Future research should evaluate menu labeling's impact on children's food choices and consumption. (*Am J Public Health.* 2010;100:312–318. doi:10.2105/AJPH.2009.160226)

Poor diet is a major public health concern.[1,2] One policy that might help improve diet quality, which has been implemented in New York City and is being considered by other cities and states, requires chain restaurants to post kilocalorie (calorie) information on menus and menu boards. The aim of menu labels is to inform consumers about foods consumed outside the home, which account for approximately half of total food expenditures.[3] The rationale is that (1) food purchased outside the home is higher in calories, of poorer nutritional quality, and served in larger portions, which promotes overconsumption[4–7]; (2) the frequency of fast food consumption is associated with greater levels of body fat[8] and overweight[9]; (3) people, including trained nutritionists,[10] have great difficulty estimating the calories in restaurant meals[11]; and (4) most consumers support calorie labeling on restaurant menus[12,13] and nearly half report it would inform their food choices.[14]

The restaurant industry has lobbied hard against proposed regulations, suing New York City, San Francisco, and Santa Clara for attempting to enact labeling requirements, although these suits were unsuccessful. One industry claim is that at least some restaurants make nutrition information available via some combination of in-store brochures, posters, and the Internet. However, the information is often not readily accessible[15] and only 0.1% of consumers seek it out.[16] Given the prominence of this issue and the strong opposition of industry, it is important to test the impact of calorie labels on food choices and consumption. Studies bearing on this matter have produced mixed findings[17–29] and have either failed to examine calorie labels on chain restaurant menus, offered study participants a limited number of food items, or studied ordering behavior but not actual consumption and neglected to examine how nutrition information presented at one meal affects subsequent food intake. We designed the current study to test whether menu labeling influences the total calories ordered and consumed during a dinner meal as well as food consumed after the meal. We also aimed to assess whether the effects would be stronger if people were provided information about recommended daily caloric requirements.

METHODS

Participants were 303 members of the New Haven, Connecticut, community recruited between August 2007 and August 2008 via flyers, word of mouth, newspaper advertisements, and craigslist.com postings. The only exclusion criterion was age younger than 18 years. All participants provided written informed consent.

Study Design

To conceal the study's purpose, individuals were told that consumer market research was being conducted and they would be asked to answer questions about their dining preferences and eating habits, order and eat a free restaurant meal, and return the next day for a brief interview. When participants arrived at 5:30 PM on the first day, they had been instructed to abstain from eating after 2:30 PM to standardize hunger levels. The experiment took place in a university classroom in a building not affiliated with eating research. Participants sat behind dividers so they could not see others' meal choices; 2 to 14 individuals participated per study session.

A random-number generator produced randomization lists stratified by sex. Participants were randomly assigned to 1 of 3 menu calorie labeling conditions: (1) a menu without any calorie labels (no calorie labels); (2) a menu with calorie labels (calorie labels); or (3) a menu with calorie labels and a label at the top left corner of the menu that read, "The recommended daily caloric intake for an average adult is 2000 calories" (calorie labels plus information).

All menus contained the same items from 2 restaurants (Au Bon Pain and a local, nonchain restaurant). Au Bon Pain was selected because it is a chain restaurant that has a Web site from which we could obtain calorie values for all menu items. Menu items included all salads, dressings, sandwiches, wraps, and selected beverages and desserts from Au Bon Pain. To ensure that the menus had diverse options, including traditional fast food, we added dishes such as mozzarella sticks, french fries, pizza, hamburgers, and cheesecake from the local restaurant. Menu item names and descriptions were altered slightly to hide the restaurants' identities. When present, calorie labels appeared in a column labeled "Calories" to the right of the menu item. For pizza, which can come with various toppings, a range of calories was provided as required by the New York City legislation. We estimated calorie values for the local restaurant items by weighing the items on an Ohaus digital scale (Ohaus Corporation, Pine Brook, NJ) accurate up to ±0.1 g and entering those weights into the Food Processor SQL calorie content database (ESHA, Salem, OR).

After randomization, participants were read a script of questions by C.A.R. about their dining preferences and completed a corresponding questionnaire as part of the guise that the study was for consumer market research. Halfway through the focus group, menus were distributed and participants were instructed by the experimenter to order whatever they liked, provided the meal represented one they might actually order when eating at a restaurant. To prevent individuals from overordering, they were told that no food could be taken home. Participants were instructed to circle their meal choices directly on the menu so they would not influence one another. While the food was retrieved from the restaurants, the focus group was completed and participants sat quietly for a few minutes and could read from magazines (which did not feature stories about weight, body image, etc.). Prior to being served, all foods were weighed and transferred to standard paper plates and plastic cups of the same size and color. After the meal, food waste was collected and weighed to allow calculation of total calories consumed. Once a participant finished the meal, questionnaires were administered, and the dietary recall interview was scheduled for the next day between 5:00 PM and 8:00 PM.

Dietary recalls were done by the Multiple Pass Method,[30] and a kit containing such items as sample measuring spoons and cups, dishware, and pictures of food was presented to participants to help them estimate portion sizes. The first several recalls were conducted by C.A.R.; 5 of these were randomly selected and reviewed by a nutritionist trained in dietary recall assessment who provided feedback. C.A.R. then trained 6 research assistants by performing mock interviews and providing feedback; these assistants then conducted the remainder of the interviews. As part of the recall, participants were instructed to report everything they ate during the evening hours immediately after the study meal. Following the recall, participants were told the purpose of the study and received $15.

Measures

The first outcome, total calories ordered, was computed by summing the calories of each menu item selected. For a small number of participants (12.9%), the restaurant ran out of their first item choice, in which case they selected another item. The second outcome, calories consumed, was determined by subtracting the calories of the food left over from the total in the meal. This assumed that what remained on the plate represented an even distribution of calories. Some participants, however, left only specific items on their plate, such as the pizza crust, in which case we calculated the total calories for the specific item on the basis of its weight information. The third outcome, calories consumed in the evening after the study dinner, was calculated from the dietary recall assessment with the www.calorie-count.com online database, which enabled us to obtain calorie information for specific brand-name foods. The fourth outcome variable comprised total calories consumed during the study meal combined with total calories consumed later that same evening. We also assessed a fifth outcome, which was the difference between actual calories consumed at the study dinner and the calories participants thought they had consumed. This was calculated by taking the absolute value of total calories consumed minus a postdinner self-reported estimate of total calories consumed.

After the study meal, participants provided self-reported height and weight (used to calculate body mass index [BMI; weight in kilograms divided by height in meters squared]), race/ethnicity, and education level. They also completed visual analog scales assessing their hunger prior to eating the meal, fullness after the meal, and how they liked the food, and completed the Three Factor Eating Questionnaire,[31] which yields disinhibition, hunger, and cognitive restraint subscales.

Statistical Methods

We performed a 1-way analysis of variance (ANOVA) to assess whether the 3 study conditions were successfully randomized by age, BMI, frequency of visiting fast food restaurants, Three Factor Eating Questionnaire subscales, and ratings of hunger, fullness, and liking of the food. We performed the χ^2 test to evaluate group differences for race/ethnicity and education level. We conducted 5 univariate ANOVAs to determine whether the menu type conditions were associated with the 5 outcome variables, and η^2 effect sizes are reported. We also performed the Kruskal–Wallis nonparametric test on skewed data to confirm ANOVA findings. We conducted posthoc least significant difference (LSD) tests to compare differences between each of the 3 menu type conditions,[32,33] and Cohen's *d* effect sizes are reported. All tests were based on a .05 significance level. We analyzed data using SPSS version 15.0 (SPSS Inc, Chicago, IL).

RESULTS

A total of 303 people participated in the study. During the course of the study, we noticed that several individuals were ordering multiple entrees but leaving some uneaten. Prior to data analysis, we therefore decided to exclude individuals who ordered several entrees (in addition to other items) if they consumed less than 50% of the total calories, since this would not represent a meal they might order in the "real world." Using this criterion, we excluded from the "total calories ordered" analysis 8 of the 12 individuals who ordered multiple entrees. An additional 8 people were excluded from all analyses: 5 whose food was mistakenly purchased from the wrong restaurant, 1 who felt ill during the meal, and 2 who did not eat anything

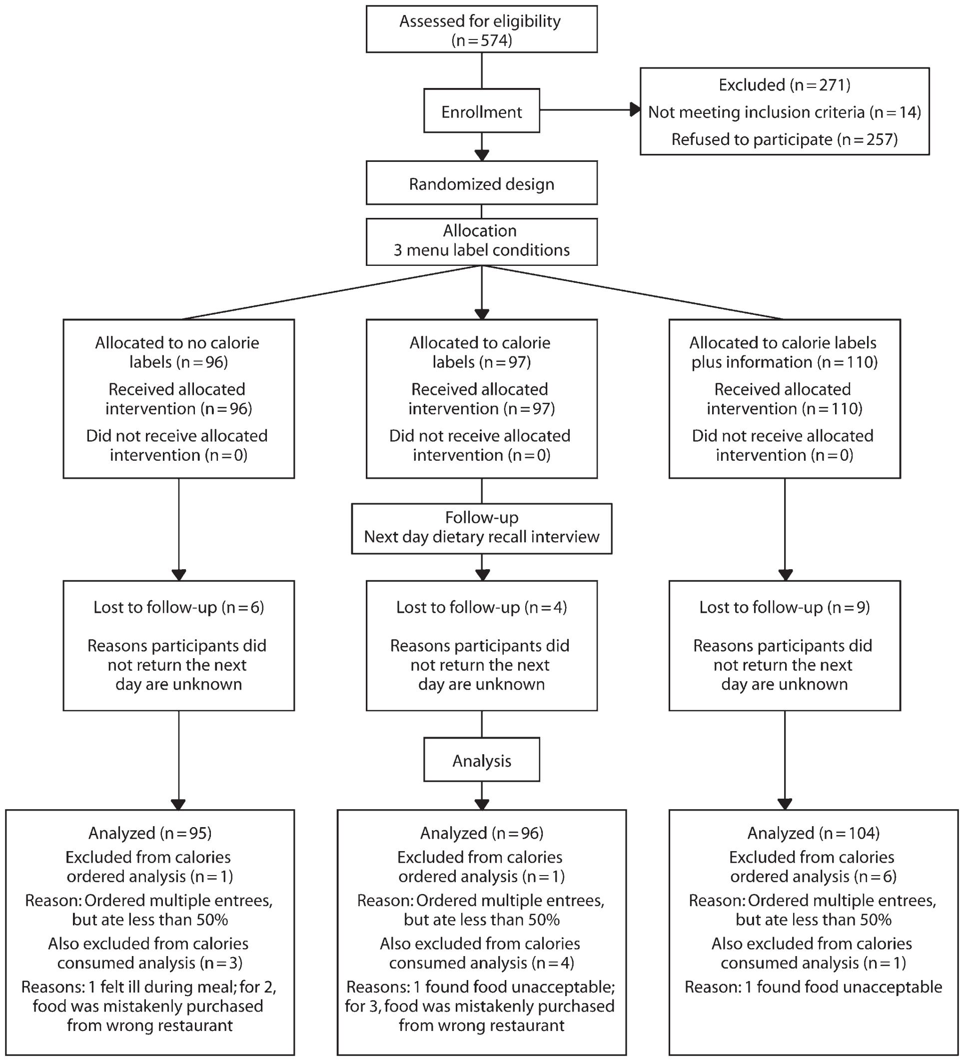

FIGURE 1—Recruitment flow chart for study of impact of restaurant menu calorie labels on food choices and intake: New Haven, CT, 2007–2008.

because they found the food unacceptable. A total of 273 participants (90.1%) completed the dietary recall interview. Figure 1 shows study recruitment and flow information.

The final sample had 147 males (49.83%) and 148 females (50.17%); on the basis of self-report, the sample was 54.6% White, 20.3% African American, 15.6% Asian, 3.4% Hispanic, 0.68% Pacific Islander, 0.34% American Indian, and 3.7% "other or biracial." A χ^2 test did not reveal any significant differences between the menu type conditions in terms of race (P=.55) or education level (P=.91). In the total sample, 3.8% had less than a high school education, 11.4% had completed high school or general equivalency diploma (GED), 32.2% had completed some college, 30.1% had completed 4 years of college, and 22.5% had a graduate degree. A 1-way ANOVA did not detect significant differences between menu type conditions in terms of age (30.5 ± 12.4 years), BMI (25.2 ±6.1 kg/m^2), degree of liking of the study meal, hunger prior to the meal, fullness following the meal, frequency of visiting fast food restaurants, or any of the Three Factor Eating Questionnaire subscales (Table 1).

Outcomes

First outcome: total calories ordered. A univariate ANOVA revealed a significant main effect of menu type on total calories ordered (P=.04; η^2=0.005). Posthoc LSD tests revealed a statistically significant difference between the no calorie labels condition and the calorie labels condition (P=.03; d=0.32) and between the no calorie labels condition and the calorie labels plus information condition (P=.03, d=0.31). There was no statistically significant difference between the calorie labels and the calorie labels plus information condition (P=.99). Participants ordered an average of 2189 calories (SD=1081) in the no calorie labels condition and 1862 calories (SD=937) and 1860 calories (SD=1063) in the calorie labels and calorie

TABLE 1—Results of 1-Way Analysis of Variance (ANOVA) for Demographic and Eating Behavior Variables of Participants Randomly Assigned to 3 Menu Label Conditions: New Haven, CT, 2007–2008

	No Calorie Label (n = 94), Mean (SD)	Calorie Label Only (n = 95), Mean (SD)	Calorie Label Plus Information (n = 104), Mean (SD)	d	F	P
Age, y	30.22 (12.54)	29.60 (12.26)	31.59 (12.48)	2274	0.64	.53
BMI, kg/m^2	25.46 (6.82)	25.74 (6.43)	24.38 (5.05)	2276	1.34	.26
Hunger level before meal[a]	7.04 (2.53)	7.54 (2.04)	6.77 (2.46)	2289	2.64	.07
Fullness after meal[a]	8.02 (1.85)	7.93 (1.78)	7.90 (1.93)	2288	0.12	.89
Degree of liking meal[a]	6.20 (2.57)	5.69 (2.45)	5.87 (2.61)	2286	0.99	.38
Frequency of visiting fast food restaurants, days	2.24 (1.62)	1.73 (1.58)	2.23 (1.87)	2289	2.76	.07
TFEQ[b]						
Restraint	7.71 (4.73)	7.88 (4.60)	8.31 (5.14)	2281	0.40	.67
Disinhibition	5.52 (3.57)	5.38 (3.03)	5.05 (3.27)	2282	0.52	.60
Hunger	4.75 (3.01)	4.85 (2.79)	4.53 (2.95)	2282	0.30	.74

Note. BMI = body mass index (weight in kilograms divided by height in meters squared); TFEQ = Three Factor Eating Questionnaire. No significant differences were observed between any of the menu type conditions.
[a]Hunger and fullness levels and degree of liking of the study meal were all measured on continuous visual analogue scales ranging from 0 to 10.
[b]The TFEQ restraint subscale is scored out of 21, the disinhibition subscale is scored out of 16, and the hunger subscale is scored out of 14.

labels plus information conditions, respectively (Table 2).

Second outcome: total calories consumed. A univariate ANOVA did not reveal a significant main effect of menu type for total calories consumed (P=.12; η^2=0.003). In the absence of significant differences between the 2 calorie label conditions for total calories ordered or consumed, we combined those 2 conditions for comparison with the no calorie labels condition using an independent samples *t* test. Total number of calories consumed in the combined label condition (1289 ± 656) was significantly lower than in the no calorie labels condition (1466 ± 724; t_{285}=2.07; P=.04; d=0.26). In addition, an exploratory *t* test comparing the no calorie labels condition with the calorie labels plus information condition was also significant (t_{193}=2.00; P=.047).

Third outcome: total calories consumed after the study meal. A univariate ANOVA assessing differences in total calories consumed later in the evening following the study meal revealed a significant main effect of menu type (P=.03; η^2=0.018). Posthoc LSD tests revealed a significant difference between the no calorie labels condition and the calorie labels condition (P=.02; d=0.33) as well as a significant difference between the calorie labels condition and the calorie labels plus information condition (P=.02; d=0.33). There were no significant differences between the calorie labels plus information condition and the no calorie labels condition (P=.96). The calorie labels condition had a higher average mean (294 ± 387) than either the no calorie labels condition (179 ± 310) or the calorie labels plus information condition (177 ± 309). Since these data were skewed, the significant difference was confirmed with the nonparametric Kruskal-Wallis test (P=.006). In addition, a χ^2 analysis examining whether individuals had an evening snack revealed a significant difference between the 3 conditions (χ^2_2=11.46; P=.003), with 57% of participants in the no calorie labels condition, 70% in the calorie labels condition, and 46% in the calorie labels plus information condition having an evening snack.

Fourth outcome: calories consumed at and after study meal. A univariate ANOVA examining the group differences for the sum of calories consumed at the study meal and calories

TABLE 2—Results of Univariate Analysis of Variance (ANOVA) for Primary Outcome Variables of Participants Randomly Assigned to 3 Menu Label Conditions: New Haven, CT, 2007–2008

	No Calorie Label (n = 95)		Calorie Label Only (n = 96)		Calorie Label Plus Information (n = 104)					
	Mean (95% CI)	SD	Mean (95% CI)	SD	Mean (95% CI)	SD	d	F	P	η^2
Total calories ordered[a,b]	2189.37 (1981, 2397)	1080.51	1862.23 (1655, 2069)	937.29	1859.7 (1661, 2058)	1062.58	2292	3.28	.04	0.005
Total calories consumed[c]	1458.92 (1319, 1598)	724.62	1334.72 (1195, 1474)	620.65	1256.37 (1125, 1388)	688.47	2284	2.18	.12	0.003
Total postdinner calories[a,d]	179.13 (108, 250)	310.34	293.64 (224, 363)	386.68	176.80 (108, 245)	308.92	2270	3.57	.03	0.018
Dinner plus postdinner calories[b,d]	1630.04 (1476, 1784)	810.73	1624.87 (1471, 1778)	741.01	1379.64 (1231, 1528)	639.26	2266	3.51	.03	0.005
Difference in estimated and actual calories consumed[a,b]	714.20 (595, 833)	605.39	508.52 (389, 628)	509.47	465.42 (351, 580)	593.89	2273	4.96	.008	0.018

[a]Significant difference between the no calorie labels and calorie labels condition at the P < .05 level.
[b]Significant difference between the no calorie labels and calorie labels plus information condition at the P < .05 level.
[c]Significant difference between the no calorie labels and the 2 calorie label conditions combined at the P < .05 level.
[d]Significant difference between the calorie labels and calorie labels plus information condition at the P < .05 level.

consumed in the evening following the meal revealed a main effect of menu type (P=.03; η^2=0.005). Posthoc LSD tests indicated that the no calorie labels condition did not significantly differ from the calorie labels condition (P=.96), but did significantly differ from the calorie labels plus information condition (P=.02; d=0.34). The 2 calorie label conditions also significantly differed from one another (P=.03; d=0.35). Participants consumed an average of 1630 calories (SD=811) in the no calorie labels condition, 1625 calories (SD=741) in the calorie labels condition, and 1380 calories (SD=639) in the calorie labels plus information condition. See Figure 2 for a summary of the main findings.

Fifth outcome: accuracy of estimating calories consumed. We also compared individuals' abilities to estimate the calories they consumed in the meal. A univariate ANOVA that included the absolute value of the difference between the calories people actually consumed and the calories they estimated consuming revealed a significant main effect of menu type (P=.008, η^2=0.018). Posthoc LSD tests revealed that there was a significant difference in ability to accurately estimate calories consumed between the no calorie labels condition and the calorie labels condition (P=.02, d=0.37), as well as a significant difference between the no calorie labels and calorie labels plus information condition (P=.003, d=0.42); the 2 calorie label conditions did not differ from one another (P=.61). People estimated more accurately in both label conditions than in the no calorie labels condition. Fifty-nine percent of the sample underestimated intake and 41% overestimated intake. A χ^2 analysis revealed a significant difference between menu label conditions (P=.001), with 74.4% underestimating and 25.6% overestimating in the no calorie labels condition, 51.7% underestimating and 48.3% overestimating in the calorie labels condition, and 50.5% underestimating and 49.5% overestimating in the calorie labels plus information condition.

All of our primary outcome analyses were repeated to explore interactions between menu type condition and sex and overweight–normal weight status (overweight defined as BMI≥25 kg/m^2), but none were significant (data not shown). We also examined how labels affected the ordering of specific items by coding each participant's order by the presence or absence of a caloric beverage, an appetizer or side dish, or a dessert. Significantly more appetizers or side dishes were ordered by participants in the no calorie labels condition (61%) than in the calorie labels condition (50.0%) or the calorie labels plus information condition (45.2%; χ^2_2=5.97; P=.051). There were no significant differences in beverage or dessert ordering patterns among the groups.

Finally, following the meal, participants were asked how many calories per day an average adult should consume. Seventy-three percent of the sample gave an accurate value (1500–2500 calories), 21% gave a value outside of this range, and 6% indicated that they did not know; a χ^2 test indicated no differences based on menu condition. Sixty-four percent of participants felt that restaurants should offer calorie labels, 19% felt they should not, and 17% had no opinion.

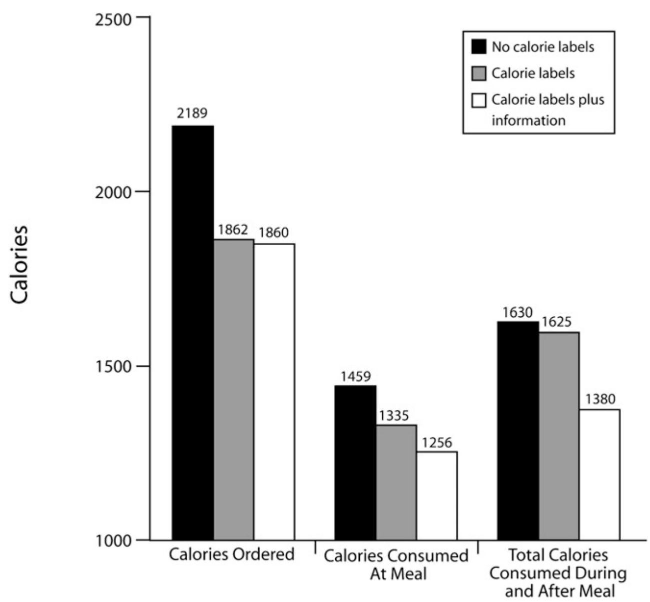

FIGURE 2—Calories ordered and consumed, by menu type: New Haven, CT, 2007–2008.

DISCUSSION

Calorie information on restaurant menus reduced the total amount of calories people ordered and consumed for a meal, improved their ability to estimate calories consumed, and, perhaps most important, affected their eating later in the day. Participants of both calorie label conditions ordered significantly fewer calories than those in the no calorie labels condition. When the 2 calorie label conditions were combined, this group's participants consumed 14% fewer calories than those in the no calorie labels condition. On average, people in the calorie labels group and the calorie labels plus information group consumed 124 and 203 fewer calories, respectively, at the dinner meal than did those in the no calorie labels condition.

Most striking was the impact of adding daily caloric requirement information to the menu. It was surprising how much participants in the calorie labels condition ate in the evening hours following the meal; when calories consumed in this condition during and after the study meal were combined, there was no advantage for calorie labeling only over no labeling. The advantage occurred when the menu included both calorie labels and a prominently displayed notice stating that the average person should consume approximately 2000 calories per day. Total caloric intake for the combination of the study meal and food consumed later was 1630 calories, 1625 calories, and 1380 calories for the no calorie labels, calorie labels only, and calorie labels plus information conditions, respectively. A 250-calorie advantage could have a significant public health impact.[34,35]

Studies have shown that people's perceptions of what they have eaten have a strong effect on what they subsequently eat.[25,26] It is possible that participants in the calorie labels only condition believed they had economized on calories by eating less at the study meal and felt hungrier later or simply believed they had greater allowance to eat more. Providing people with information about daily calorie intake at the point of purchase provided a context for the other calorie information on the menu that appeared to eliminate excess eating later. Therefore, adding this labeling requirement is essential.

This study has several limitations. We estimated calorie values for the local restaurant items and dietary recall items via standard calorie databases rather than assessing them directly. Also, dietary recall data suffer from additional measurement error given people's difficulty in estimating portion sizes. However, since the primary focus of the dietary recalls was on the postdinner time frame, the accuracy for assessing snacks, often composed of 1 or 2 items, is more reliable than assessing entire meals. Another limitation is that no price information appeared on the menus, which prevented us from assessing the interaction between price and calorie labels. In addition, individuals were not followed over time, so we could not assess how exposure to the labels affected food choices beyond the day of the study. Finally, participants were a convenience sample and were not randomly sampled from a nationally representative group, which may have introduced selection bias.

This study improves upon past research by being the first, to our knowledge, to assess the impact of providing calorie information as required by existing policy and to determine the effect of daily caloric requirement information in conjunction with the calorie labels on subsequent eating. The study's internal validity is strengthened by its use of randomization, and external validity is strengthened by the inclusion of a community sample of both men and women of different races/ethnicities with a range of BMIs (though BMI data were self-reported). We also included a range of high- and low-calorie items from popular fast food and local restaurants, although no menu item was greater than 1500 calories despite the fact that many restaurant items surpass 2000 calories. Presumably, if we used a broader range of calorie values we would see greater effects. This study also improves on past research by having participants order food they would actually be consuming and assessing food consumption. A final strength is that we were able to capture how calorie labels may affect food consumption at a later point in time.

The findings support the proposal that chain restaurants should be required to post calorie labels on restaurant menus; however, they suggest that to maximize the effectiveness of this policy, menus should also include a label informing individuals of the daily caloric requirements for an average adult.

Future research should examine the interaction between menu labels and price information as well as the placement of calorie labels on menu boards to improve effectiveness. It will also be important to determine how calorie labels affect the choices and consumption of adolescents, as well as of parents and children eating a meal together. ■

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Contributors

C.A. Roberto originated the study idea and design, helped with data acquisition, performed data analysis, and led the writing. P.D. Larsen, H. Agnew, and J. Baik recruited study participants, helped with acquisition of data, and provided additional administrative support. K.D. Brownell provided input on the study design, helped interpret the results, and provided critical feedback on drafts of the article.

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Human Participant Protection

This study was approved by the Human Subjects Committee of Yale University.

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