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# Five Years Later: Awareness Of New York City's Calorie Labels Declined, With No Changes In Calories Purchased

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**ABSTRACT** To follow up on a previous study that examined how the mandated displaying of calorie information on menu boards in fast-food restaurants in New York City influenced consumers' behavior, we analyzed itemized cash register receipts and survey responses from 7,699 consumers at four fast-food chains. Using a difference-in-differences study design, we found that consumers exposed to menu labeling immediately after the mandate took effect in 2008 and at three points in 2013–14 reported seeing and using the information more often than their counterparts at fast-food restaurants without menu labeling. In each successive period of data collection, the percentage of respondents noticing and using the information declined, while remaining above the prelabeling baseline. There were no statistically significant changes over time in levels of calories or other nutrients purchased or in the frequency of visits to fast-food restaurants. Menu labeling at fast-food chain restaurants, which the Affordable Care Act requires to be implemented nationwide in 2016, remains an unproven strategy for improving the nutritional quality of consumer food choices at the population level. Additional policy efforts that go beyond labeling and possibly alter labeling to increase its impact must be considered.

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The high prevalence of overweight and obesity in the United States has been well documented. Thirty-five percent of US adults are obese,<sup>1</sup> and the rate is predicted to rise to 42 percent by 2030.<sup>2</sup> Individuals who are overweight or obese are at increased risk of heart disease, stroke, type 2 diabetes, and certain types of cancer.<sup>3</sup> Their annual medical costs are \$1,429 (42 percent) greater than those of individuals of normal weight.<sup>4</sup>

Few policies have been enacted in the United States that were intended to alter food consumption patterns. A notable exception is the mandatory posting of calorie information on menus in chain restaurants. In July 2008 New York City became the first jurisdiction to enact such a poli-

cy. The law requires restaurant chains with at least fifteen locations to post the calorie content of all items regularly on their menus in a typeface and format similar to that of the item's price or name.<sup>5</sup> It applies only to chain restaurants, which accounted for approximately a third of all restaurant traffic in New York City in 2007.<sup>6</sup>

The Affordable Care Act included a federal mandate that expanded calorie labeling nationally, specifying that restaurant chains with more than twenty locations must post calorie information on their menus. After much delay, the rule was finalized in late 2014,<sup>7</sup> and compliance is now required by December 1, 2016.<sup>8</sup>

Calorie labeling is intended at least in part to assist consumers in making more informed and healthier decisions at restaurants than they

would in the absence of calorie information.<sup>9</sup> This is particularly important because Americans eat food away from home—a behavior correlated with poorer health outcomes, compared to eating food prepared at home<sup>10</sup>—with increasing frequency.<sup>11</sup> Fast food in particular is often sold in large portions and is high in calories.<sup>12</sup> Another way that calorie labeling could lead to reduced calorie consumption at fast-food restaurants is by encouraging customers to visit those establishments less often.

However, the evidence for the short-term effectiveness of calorie labeling at fast-food restaurants is mixed at best. Previous studies of New York City's rule in particular found no overall short-term impacts on calories purchased.<sup>13,14</sup> Several recent reviews concluded that for the most part, calorie information on fast-food restaurant menu boards affected neither purchases nor consumption.<sup>15-18</sup> Furthermore, posted calorie information did not reduce customers' frequency of visiting fast-food restaurants in the one study that examined this outcome.<sup>19</sup>

Most studies conducted in restaurant settings with calorie labeling were conducted between several months and two years after cities implemented their labeling policies.<sup>13,14,19</sup> It is possible that longer or repeated exposure to labeling is necessary before some customers start to change their behavior. Alternatively, fewer consumers might pay attention to the information as its novelty wears off.

A handful of studies have assessed the somewhat long-term effect of posted calorie information on menu boards in fast-food restaurants. Roxana Chen and coauthors used the Behavioral Risk Factor Surveillance System and found that in Seattle/King County, Washington, the percentage of the population who reported seeing and using calorie labels during their most recent visit to a fast-food chain restaurant increased at one year and then again at two years after implementation of a requirement for chain restaurants to post calorie labels.<sup>20</sup>

Also in Seattle/King County, James Krieger and colleagues collected receipts at point of purchase and found that the percentage of consumers who noticed and used the information increased at six months and remained relatively constant at eighteen months.<sup>21</sup> Calories purchased declined in taco and coffee locations at eighteen months, but not in burger and sandwich restaurants. However, the study lacked a comparison group, so it is not clear if this finding was due to the calorie labeling policy or to some other unknown or unmeasured factor.

Finally, Brandon Restrepo examined survey data from New York State and noted a reduction in average body mass index over a period of two

to four years for people in counties that implemented a mandatory calorie labeling law, compared to those in counties that did not.<sup>22</sup> This study has not been peer reviewed or published, and it is of note that the decline appears to be apparent in the period before labeling began.

Following up on a 2009 article by one of the authors (Brian Elbel) and colleagues, we expand this longitudinal work by using an even longer time period.<sup>14</sup> New York City's calorie labeling policy has been in place for over six years. As did Krieger and colleagues,<sup>21</sup> we collected customer receipts at the point of purchase, which allowed us to examine calories purchased. Additionally, our study included a comparison group, which allowed us to attribute—more directly than Krieger and colleagues, even if not fully—any change observed to the policy instead of to forces such as menu reformulations unrelated to labeling or cultural shifts toward ordering lower-calorie meals.

We report changes in the percentages of customers who noticed the posted calorie labels, who reported using the labels, and who reported using them to reduce the number of calories purchased at four major fast-food chains in predominantly low-income, high-minority areas of New York City. Furthermore, we report changes in the number of calories, grams of saturated fat, milligrams of sodium, and grams of sugar in food and beverages purchased. Finally, we track trends in the frequency of visits to fast-food restaurants over time.

## Study Data And Methods

**CHOICE OF CITIES** This study used data from surveys and cash register receipts collected in 2008 and 2013–14 in a difference-in-differences analysis. The 2008 data were collected before and soon after the implementation of New York City's calorie labeling law. In 2013–14 we conducted a policy assessment of New York City's Sugary Drinks Portion Cap Rule using a similar methodology, and we included in our survey a “calorie labeling” module as a follow-up to the 2008 study.

In 2008 we selected Newark, New Jersey, as the comparison city for the following reasons: It had not introduced calorie labeling, unlike New York City; its urban and demographic characteristics were similar to those of New York City; and it did not have a vast number of daily commuters to New York City.<sup>14</sup> In 2013–14 we selected Newark and neighboring Jersey City as comparison cities for New York City through a method that assesses the degree of similarity between observations (in this case, cities) with regard to a set of demographic characteristics.

**CHOICE OF NEIGHBORHOODS AND RESTAURANTS** Four restaurant chains with the largest presence in New York City and Newark in 2008 (Burger King, KFC, McDonald's, and Wendy's) were studied across all years of the study. In 2008 New York City and Newark neighborhoods with restaurants in the selected chains were matched based on population size, age, race/ethnicity, poverty level, obesity rate, and diabetes rate. Within the neighborhoods we matched restaurant locations by chain name and attempted to match key structural and geographic characteristics that might affect customer mix, such as nearby public transportation stations and housing complexes.

We selected a disproportionate number of restaurant locations in low-income, high-minority neighborhoods. A similar procedure to that used in 2008 was used to select the restaurant locations studied in 2013–14. However, the comparison area was expanded to include Jersey City as well as Newark, and a larger set of sites was selected. Some of the sites were outside traditionally low-income areas, but given the location of restaurants within these neighborhoods, the sites are prominent in our data.

Nineteen restaurants were surveyed in 2008 and sixty in 2013–14. The numbers of locations surveyed and of receipts collected by location and restaurant chain can be found in online Appendix 1.<sup>23</sup>

**PARTICIPANT RECRUITMENT AND DATA COLLECTION PROCEDURES** At the selected fast-food restaurants, trained data collectors approached or “intercepted” all customers who appeared to be eighteen years or older as they entered. Customers were told that they could receive \$2 for answering a few questions and providing their register receipt following their visit. Restaurants were surveyed during lunch and dinner hours.

In 2008, data were collected July 8–17, before calorie labeling was implemented in New York City, and August 19–28, after the implementation. In 2013–14, data were collected during three periods before New York City's beverage portion cap policy was to go into effect. These periods were January–April of 2013, August–November of 2013, and January–June of 2014.

There were two methodological differences between the studies in 2008 and in 2013–14. First, although the incentive for completing the survey in 2013–14 was the same as in 2008 (\$2), participants in the later study were also offered the chance to participate in a separate follow-up telephone survey that would pay \$10. Second, in 2013–14 a Spanish version of the survey was offered along with an English version. Few surveys were conducted in Spanish, and our overall results were the same whether we included or

excluded the Spanish surveys.

**MEASURES** When a data collector encountered a customer leaving a restaurant, the collector confirmed which items on the receipt had been purchased for the customer's own consumption and then administered a short survey. The questions asked about food and drink customizations (for example, the addition of extra cheese to a sandwich), whether the items were consumed in the restaurant or taken to go, and whether the items were shared with anyone else. Participants were also asked to identify their race/ethnicity, age, sex, and location of residence.

A set of nested questions were asked during all data collection periods. These questions included whether the respondent saw “any calorie information in the restaurant”; those who said yes were asked whether the information influenced their purchase. Those who said that it had were then asked how the calorie information influenced the purchase, with the option of replying either, “I bought food that was lower in calories,” or “I bought food that was higher in calories.” Participants were also asked to report the number of times they ate fast food per week (at breakfast, lunch, and dinner and as a snack). There were slight word changes in the survey from 2008 to 2013–14; for the wording of both versions, see Appendix 2.<sup>23</sup>

Collected receipts were analyzed for the nutritional content of the purchase. Information on the calorie, saturated fat, sodium, and sugar content of standardized menu choices was gathered from the restaurant chains' websites. Values were adjusted to account for customer-requested modifications (such as extra cheese), which were confirmed as part of the survey.

**STATISTICAL ANALYSIS** Data from the five rounds of data collection were aggregated. Respondents were classified into either the intervention group or the comparison group based on the presence of posted calorie information on menu boards at the time of data collection. The comparison group consisted of customers at the 2008 New Jersey restaurants and at the 2013–14 New Jersey restaurants, with the notable exception of McDonald's locations in New Jersey in 2013–14. McDonald's implemented voluntary calorie labeling at all locations nationwide in 2012,<sup>24</sup> so data from these New Jersey restaurants were included in the intervention group. The intervention group consisted of customers at the 2008 and 2013–14 New York City restaurants and at the 2013–14 New Jersey McDonald's locations.

Two difference-in-differences models were run on the survey data, focusing on different sets of outcome variables. To establish how our survey sample changed over time, the first model in-

cluded only a categorical indicator for time period (pre- or post-implementation of labeling), a categorical indicator for whether the survey respondent belonged to the intervention or comparison group, and an interaction between the time period and intervention indicators. The outcomes of interest were the demographic variables.

The second model established the impact of labeling and included the same time-period categorical indicator, intervention categorical indicator, and interaction between the two. It also included as control variables the respondent's sex, age, and race/ethnicity; the restaurant chain; and whether the purchase was for eating in or to go.

Logit regressions were run to predict the likelihood of reporting three activities: seeing the posted calorie information, using the information, and using the information to purchase fewer calories. For continuous outcomes, ordinary least squares regressions were run using the same specifications. The outcomes of interest in these models were the frequency of visits to fast-food restaurants and the nutritional content (calories, saturated fat, sodium, and sugar) of the items purchased.

All of the outcome regressions included robust standard errors that were clustered at the restaurant-location level. Each of the regressions was stratified by respondent's sex and race/ethnicity and by restaurant chain, and those results can be found in Appendixes 7–14.<sup>23</sup> We did not find any differences between them and the results for the full sample.

In addition, as a sensitivity test we ran regression models that combined all three long-term follow-up periods. This did not influence the main results, either. All analyses were performed using Stata, version 13.

**STRENGTHS AND LIMITATIONS** Our study had several strengths. First, it is the first peer-reviewed published study to track the long-term effect (beyond two years) of a calorie labeling mandate. Second, we tracked real-world fast-food purchasing in an objective manner instead of relying on subjective reports. Third, we used a comparison group to net out secular trends or changes in purchasing unrelated to the introduction of menu labeling.

We also note several limitations of the study. First, our sample could suffer from selection bias, whether at the city, chain, restaurant, or participant level. Unfortunately, we do not know the response rate for our consumer survey. However, one study that used essentially the same sampling procedure reported participation rates as high as 60 percent.<sup>13</sup> To mitigate this bias, we used the same sampling technique over time.

## As chain restaurant calorie labeling rolls out nationally, there are several potential policy implications to consider.

Second, our survey respondents might have behaved differently than they would have otherwise because they were told that they would receive a monetary incentive for participating in a study. Again, our estimates of the impact of the mandatory posting of calorie information should be unaffected by any such difference, since we used a similar sampling procedure over time. Participants were not told in advance what the survey topic was or what behaviors were under observation. Thus, we expect that the incentive had minimal influence on the studied behavior.

Third, our results can be generalized only to the behavior of consumers at fast-food restaurants located in New York City and New Jersey, and for a predominantly low-income, high-minority sample. Different types of consumers at other types of businesses with labeling, particularly sit-down restaurants,<sup>25</sup> might respond to labeling quite differently. Compared to fast-food restaurants, other types of restaurants might have a wider breadth of choices and might give consumers a longer amount of time to consider the menu.

Fourth, some measurement considerations should be kept in mind. Our study sample was larger than that of some other studies. However, our study was not powered to observe small changes as a result of labeling. Measuring actual calories consumed would be a more direct proxy for a change in obesity than measuring calories purchased. A related point is that we did not observe actual calories consumed, only purchases. This is a reasonable proxy for calories consumed, and other studies<sup>26,27</sup> have shown that consumers eat most of what they purchase. Similarly, we did not observe behaviors that might occur outside the restaurant after seeing labeling, such as modifying calorie consumption later in the day.<sup>28</sup> And we did not attempt to determine why noticing and responding to labeling might have declined over time, such as frequent visitors

to fast-food restaurants becoming habituated to the information.

Fifth, there were some changes between the 2008 study and the 2013–14 study. As noted above, the wording of the survey questions changed slightly over time, which could have influenced responses (Appendix 2).<sup>23</sup> The sampled restaurant locations also changed, and one restaurant chain voluntarily introduced labeling. However, the demographic differences in the sample over time were not overwhelmingly large, occurred in both the intervention and the comparison groups, and were controlled for in the impact analysis. Specificity tests—such as excluding in the later rounds the parts of New Jersey that were not sampled in the earlier rounds, excluding McDonald’s restaurants (which voluntarily introduced labeling), and controlling for demographic characteristics of the restaurant location at the ZIP-code level—did not change our conclusions.

Sixth, we do not know why some survey respondents in both New York City and New Jersey reported seeing and using calorie information in restaurants where it was not posted. Respondents may have been giving the answer that they believed the data collector wanted to hear. It is also possible that participants looked at printed brochures or accessed the restaurant’s menu on a smartphone while in the restaurant,

but at least one study has shown that this almost never occurs.<sup>29</sup> This finding shows the importance of including a baseline and comparison group to understand the overall impact of calorie information on menu boards. The potential misreporting of seeing the information might also partially explain why, although we found a subset of customers who reported seeing and using the information, we did not see any change in total calories purchased (which would also be the case if the changes made by customers were too small to cause an overall impact).

Finally, restaurants might have made changes to the formulation, size, or availability of food items during the five-year study period. On the whole, there was a decline in the average number of calories for menu items at large chain restaurants between 2012 and 2014, within our sampling period.<sup>30</sup> However, this change cannot be attributed to labeling.

## Study Results

**SAMPLE DEMOGRAPHIC CHARACTERISTICS** Across the entire study period, the sample was evenly divided between males and females (Exhibit 1). Forty-eight percent of the entire sample was African American, and 34 percent was Hispanic. The mean age of the survey respondents was 41.0 ( $\pm 15.2$ ) years. Approximately 41 percent of the

### EXHIBIT 1

Characteristics Of Point-Of-Purchase Survey Sample

	Total sample	Intervention group					Comparison group				
		2008		2013-14			2008		2013-14		
		Pre <sup>a</sup>	Post 1 <sup>a</sup>	Post 2 <sup>b</sup>	Post 3 <sup>b</sup>	Post 4 <sup>b</sup>	Pre <sup>c</sup>	Post 1 <sup>c</sup>	Post 2 <sup>d</sup>	Post 3 <sup>d</sup>	Post 4 <sup>d</sup>
Number	7,699	327	435	2,005	1,752	1,597	155	151	466	385	426
Sex											
Male	50%	38%	36%	51%	50%	50%	40%	42%	58%	60%	63%**
Female	50	62	64	49	50	50	60	58	42	40	37**
Age (years)											
Mean	41	38	38	41	41	42	40	37	42	42	42
Race/ethnicity											
African American	48%	58%	64%	42%	42%	47%	74%	83%	55%	48%	58%
White	11	10	6	13	12	10	7	5	9	12	11
Hispanic	34	24	22	37	38	39	15	11	30	33	23
Asian or other	7	7	8	7	7	5	4	1	6	7	8***
Meal was eat in or to go											
To go	59%	66%	63%	54%	66%	57%	65%	72%	57%	58%	62%
Eat in	41	34	37	46	34	43	35	28	43	42	38

**SOURCE** Authors’ analysis. **NOTES** “Pre” is the period before the intervention (July 8–17, 2008). “Post 1” is the first period after the intervention (August 19–28, 2008), “post 2” the second period after it (January–April, 2013), “post 3” the third period after it (August–November, 2013), and “post 4” the fourth period after it (January–June 2014). Logit regressions were used for dichotomous outcomes. Ordinary least squares regressions were used for continuous variables. Models included a categorical round variable, a dummy variable for whether the observation belonged to the comparison group (no calorie labels posted) or the intervention group (calorie labels posted), and an interaction between the two variables. Significance refers to differences between the intervention group and the comparison group, relative to their differences in the pre period. For full results, see Appendix 3 (see Note 23 in text). <sup>a</sup>New York City observations only. <sup>b</sup>New York City observations and New Jersey McDonald’s observations. <sup>c</sup>New Jersey observations only. <sup>d</sup>New Jersey Wendy’s, KFC, and Burger King observations only. \*\* $p < 0.05$  \*\*\* $p < 0.01$

sample reported eating their purchased meal in the restaurant, versus getting the meal to go.

There were some differences between the 2008 and the 2013–14 samples, but the differences were generally consistent in both the intervention and comparison groups. Compared to the 2008 sample, the 2013–14 sample included more males, more Hispanics but fewer African Americans, and a smaller percentage of customers who purchased their meals to go. But the difference-in-differences results in Exhibit 1 show that the only significant changes that occurred differentially were in the fourth follow-up period and were related to respondents' sex and to their being in the "Asian or other" racial/ethnic category. We controlled for differences in the distribution of demographic characteristics between the two groups in the subsequent models.

**SEEING AND USING LABELS** Fourteen percent of New York City survey respondents reported noticing calorie information in the restaurant they visited before that information appeared on menu boards (Exhibit 2; for a graphical presentation of the results, see Appendix 5).<sup>23</sup> Soon after the introduction of the information in New York City, 51 percent of respondents in the intervention group reported noticing the information—a significant increase relative to that in the comparison group. During 2013–14 that percentage in the intervention group decreased in each of the three consecutive periods (an F-test revealed that these results were different from each other at the 1 percent level).

The percentages of customers who reported using the calorie information showed a similar trend. After the information was posted on fast-food restaurants' menu boards, the number of survey respondents in the intervention group who reported being influenced by the calorie information rose to 13 percent from a baseline of 2 percent (Exhibit 2). Twelve percent reported

using the calorie information to order fewer calories. In 2013–14 the percentages of customers in the intervention group who reported being influenced and ordering fewer calories remained fairly constant, although a bit lower than the percentage in first post period. However, because there was a small increase in these values in the comparison group, the overall impact decreased slightly. According to an F-test, the three post-period labeling results were different from each other at the 5 percent level.

**NUTRITIONAL CONTENT OF PURCHASES AND FREQUENCY OF VISITS** We found no significant changes relative to baseline in any of the nutrition content purchased (Exhibit 3). Between 2008 and 2013–14 the average number of calories purchased increased in both the intervention and comparison groups. There was no significant trend in the frequency of respondents' visits to fast-food restaurants in the seven days before they were surveyed.

## Discussion

This was the first study to use a comparison group and receipt collection to assess the long-term impact on consumer behavior of posted calorie information on menu boards in fast-food restaurants. We found that posted calorie information increased the likelihood of customers' reporting having seen nutrition information in the restaurant, reporting using the information, and reporting using it to reduce the number of calories consumed. However, the magnitude of each effect declined over a five-year period. We found no consistent change in the nutritional content of foods and beverages purchased or in how often respondents purchased fast food.

Our data are not directly comparable to those in the two other peer-reviewed published studies<sup>20,21</sup> that looked at the longer-term impact of

### EXHIBIT 2

Regression-Adjusted Percentages Of Reporting Seeing Posted Calorie Labels, Using Them, And Using Them To Order Fewer Calories

	Intervention group					Comparison group				
	2008		2013–14			2008		2013–14		
	Pre <sup>a</sup>	Post 1 <sup>a</sup>	Post 2 <sup>b</sup>	Post 3 <sup>b</sup>	Post 4 <sup>b</sup>	Pre <sup>c</sup>	Post 1 <sup>c</sup>	Post 2 <sup>d</sup>	Post 3 <sup>d</sup>	Post 4 <sup>d</sup>
Saw the labels	14%	51%	45%	41%	37%	10%	16%***	16%***	19%***	19%***
Used the labels	2	13	11	11	11	3	3***	3***	5***	6***
Used the labels to order fewer calories	2	12	9	9	9	2	2***	3***	5***	5***

**SOURCE** Authors' analysis. **NOTES** The study periods are explained in the notes to Exhibit 1. A logit model was used that included a categorical round variable, a dummy variable for whether the observation belonged to the comparison group (no labels posted) or the intervention group (labels posted), and an interaction between the two variables. Other covariates were respondent's age, sex, and race/ethnicity; restaurant chain; and whether the meal was to go or to eat in. Significance refers to differences between the intervention group and the comparison group, relative to their differences in the pre period. Robust standard errors were clustered at the restaurant-location level. For full results, see Appendix 4 (see Note 23 in text). <sup>a</sup>New York City observations only. <sup>b</sup>New York City observations and New Jersey McDonald's observations. <sup>c</sup>New Jersey observations only. <sup>d</sup>New Jersey Wendy's, KFC, and Burger King observations only. \*\*\* $p < 0.01$

**EXHIBIT 3**

**Regression-Adjusted Nutrient Content For Food Purchases And Number Of Visits To Fast-Food Restaurants, Before And After Calorie Labels Were Posted In Restaurants**

	Intervention group					Comparison group				
	2008		2013-14			2008		2013-14		
	Pre <sup>a</sup>	Post 1 <sup>a</sup>	Post 2 <sup>b</sup>	Post 3 <sup>b</sup>	Post 4 <sup>b</sup>	Pre <sup>c</sup>	Post 1 <sup>c</sup>	Post 2 <sup>d</sup>	Post 3 <sup>d</sup>	Post 4 <sup>d</sup>
Calories (kcal)	796	783	839	835	804	773	756	845	802	857
Saturated fat (g)	12	10	12	12	12	12	11	12	11	12
Sodium (mg)	1,323	1,283	1,431	1,395	1,382	1,201	1,233	1,470	1,302	1,440
Sugar (g)	41	39	34	37	32	41	34	38	40	42
Visits in the past week	6.5	6.4	5.1	5.8	5.4	7.6	6.8	5.8	5.9	4.9

**SOURCE** Authors' analysis. **NOTES** The study periods are explained in the notes to Exhibit 1. An ordinary least squares model was used on each of the outcome measures; it included a categorical round variable, a dummy variable for whether the observation belonged to the comparison group (no labels posted) or the intervention group (labels posted), and an interaction between the two variables. Other covariates were respondent's age, sex, and race/ethnicity; restaurant chain; and whether the meal was to go or eat in. No differences between the intervention group and the comparison group, relative to their differences in the pre period, were significant ( $p < 0.05$ ). Robust standard errors were clustered at the restaurant-location level. For full results, see Appendix 6 (see Note 23 in text). <sup>a</sup>New York City observations only. <sup>b</sup>New York City observations and New Jersey McDonald's observations. <sup>c</sup>New Jersey observations only. <sup>d</sup>New Jersey Wendy's, KFC, and Burger King observations only.

labeling, given that we looked at a much longer time period than the previous studies. While they found that labeling use increased over a period from eighteen months to two years after being implemented, our study, using a comparison group, found that labeling use declined five to six years after labeling began, with no change in calories purchased.

Despite earlier indications that the effectiveness of calorie labeling at fast-food restaurants in New York City might be limited, there was hope that the long-term impact of the labeling might be greater.<sup>13,14</sup> We did not find this to be the case.

As chain restaurant calorie labeling rolls out nationally, there are several potential policy implications to consider. First, and most important, it is necessary to recognize the inherent limitations of labeling, at least within fast-food restaurants, in altering population-level obesity rates for customers of fast-food restaurants in the areas we studied. Additional policy efforts over and above labeling must be considered in this light.

Second, policy makers might consider an awareness campaign. However, the population-level effectiveness of such campaigns has not been proven.

Third, calorie information might be more ef-

fective if the information were displayed differently. Laboratory studies have shown encouraging responses to the use of stop signs for less healthful foods and exercise equivalents needed to burn the calories in specific menu items, ranking items according to their calorie content, or supplementing the existing numbers with the recommended number of calories to consume in a day or at a meal.<sup>31-34</sup> These approaches are untested in fast-food restaurants,<sup>32</sup> however, and the likelihood of their being adopted at a policy level is limited.

**Conclusion**

As the nation prepares for posted calorie information on fast-food menu boards in every city and state, researchers should continue to explore the long-term effects of the policy, particularly in non-fast-food settings, where fewer data are available and results might be quite different compared to fast-food settings. Equally important, it must be recognized that only a subset of consumers report finding this information useful, and thus far its success in altering choice at a population level is unproven. Therefore, other options must be considered as ways to combat obesity. ■

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## NOTES

- 1 Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011–2012. *JAMA*. 2014;311(8):806–14.
- 2 Finkelstein EA, Khavjou OA, Thompson H, Trogdon JG, Pan L, Sherry B, et al. Obesity and severe obesity forecasts through 2030. *Am J Prev Med*. 2012;42(6):563–70.
- 3 Dixon JB. The effect of obesity on health outcomes. *Mol Cell Endocrinol*. 2010;316(2):104–8.
- 4 Finkelstein EA, Trogdon JG, Cohen JW, Dietz W. Annual medical spending attributable to obesity: payer- and service-specific estimates. *Health Aff (Millwood)*. 2009;28(5):w822–31. DOI: 10.1377/hlthaff.28.5.w822.
- 5 New York City Department of Health and Mental Hygiene. Notice of intention to repeal and reenact §81.50 of the New York City Health Code: notice of public hearing [Internet]. New York (NY): The Department; 2007 Oct 18 [cited 2015 Sep 2]. Available from: <http://www.nyc.gov/html/doh/downloads/pdf/public/notice-intention-hc-art81-50-1007.pdf>
- 6 Farley TA, Caffarelli A, Bassett MT, Silver L, Frieden TR. New York City's fight over calorie labeling. *Health Aff (Millwood)*. 2009;28(6):w1098–109. DOI: 10.1377/hlthaff.28.6.w1098.
- 7 Food and Drug Administration. Food labeling; nutrition labeling of standard menu items in restaurants and similar retail food establishments. Final Rule. *Fed Regist*. 2014; 79(230):71155–259.
- 8 Tavernise S. Deadline for calorie-count labeling on menus is extended. *New York Times*. 2015 Jul 10.
- 9 Loewenstein G. Confronting reality: pitfalls of calorie posting. *Am J Clin Nutr*. 2011;93(4):679–80.
- 10 Berman M, Lavizzo-Mourey R. Obesity prevention in the information age: caloric information at the point of purchase. *JAMA*. 2008;300(4):433–5.
- 11 Liu M, Kasteridis P, Yen ST. Breakfast, lunch, and dinner expenditures away from home in the United States. *Food Policy*. 2013;38(1):156–64.
- 12 Bates K, Burton S, Howlett E, Huggins K. The roles of gender and motivation as moderators of the effects of calorie and nutrient information provision on away-from-home foods. *J Consum Aff*. 2009; 43(2):249–73.
- 13 Dumanovsky T, Huang CY, Nonas CA, Matte TD, Bassett MT, Silver LD. Changes in energy content of lunchtime purchases from fast food restaurants after introduction of calorie labelling: cross sectional customer surveys. *BMJ*. 2011;343:d4464.
- 14 Elbel B, Kersh R, Brescoll VL, Dixon LB. Calorie labeling and food choices: a first look at the effects on low-income people in New York City. *Health Aff (Millwood)*. 2009;28(6):w1110–21. DOI: 10.1377/hlthaff.28.6.w1110.
- 15 Kiszko KM, Martinez OD, Abrams C, Elbel B. The influence of calorie labeling on food orders and consumption: a review of the literature. *J Community Health*. 2014;39(6):1248–69.
- 16 Long MW, Tobias DK, Cradock AL, Batchelder H, Gortmaker SL. Systematic review and meta-analysis of the impact of restaurant menu calorie labeling. *Am J Public Health*. 2015;105(5):e11–24.
- 17 Sinclair SE, Cooper M, Mansfield ED. The influence of menu labeling on calories selected or consumed: a systematic review and meta-analysis. *J Acad Nutr Diet*. 2014;114(9):1375–88.
- 18 Swartz JJ, Braxton D, Viera AJ. Calorie menu labeling on quick-service restaurant menus: an updated systematic review of the literature. *Int J Behav Nutr Phys Act*. 2011;8:135.
- 19 Elbel B, Mijanovich T, Dixon LB, Abrams C, Weitzman B, Kersh R, et al. Calorie labeling, fast food purchasing and restaurant visits. *Obesity (Silver Spring)*. 2013; 21(11):2172–9.
- 20 Chen R, Smyser M, Chan N, Ta M, Saelens BE, Krieger J. Changes in awareness and use of calorie information after mandatory menu labeling in restaurants in King County, Washington. *Am J Public Health*. 2015;105(3):546–53.
- 21 Krieger JW, Chan NL, Saelens BE, Ta ML, Solet D, Fleming DW. Menu labeling regulations and calories purchased at chain restaurants. *Am J Prev Med*. 2013;44(6):595–604.
- 22 Restrepo B (Food and Drug Administration, Washington, DC). Calorie labeling in chain restaurants and body weight: evidence from New York [Internet]. San Domenico di Fiesole (Italy): Max Weber Programme; 2015 Jun 2 [cited 2015 Sep 2]. Available from: [http://www.mwpweb.eu/1/154/resources/research\\_245\\_1.pdf](http://www.mwpweb.eu/1/154/resources/research_245_1.pdf)
- 23 To access the Appendix, click on the Appendix link in the box to the right of the article online.
- 24 McDonald's [Internet]. Oak Brook (IL): McDonald's. News release, McDonald's USA adding calorie counts to menu boards, innovating with recommended food groups, publishes nutrition progress report; 2012 Sep 12 [cited 2015 Sep 3]. Available from: <http://news.mcdonalds.com/US/releases/McDONALD%E2%80%99S-USA-ADDING-CALORIE-COUNTS-TO-MENU-BOARD#>
- 25 Auchincloss AH, Mallya GG, Leonberg BL, Ricchezza A, Glanz K, Schwarz DF. Customer responses to mandatory menu labeling at full-service restaurants. *Am J Prev Med*. 2013;45(6):710–9.
- 26 Schwartz J, Riis J, Elbel B, Ariely D. Inviting consumers to downsize fast-food portions significantly reduces calorie consumption. *Health Aff (Millwood)*. 2012;31(2):399–407.
- 27 Wansink B, Painter JE, North J. Bottomless bowls: why visual cues of portion size may influence intake. *Obes Res*. 2005;13(1):93–100.
- 28 Roberto CA, Larsen PD, Agnew H, Baik J, Brownell KD. Evaluating the impact of menu labeling on food choices and intake. *Am J Public Health*. 2010;100(2):312–8.
- 29 Roberto CA, Agnew H, Brownell KD. An observational study of consumers' accessing of nutrition information in chain restaurants. *Am J Public Health*. 2009;99(5):820–1.
- 30 Bleich SN, Wolfson JA, Jarlenski MP. Calorie changes in chain restaurant menu items: implications for obesity and evaluations of menu labeling. *Am J Prev Med*. 2015;48(1):70–5.
- 31 Bleich SN, Herring BJ, Flagg DD, Gary-Webb TL. Reduction in purchases of sugar-sweetened beverages among low-income Black adolescents after exposure to caloric information. *Am J Public Health*. 2012;102(2):329–35.
- 32 Liu PJ, Roberto CA, Liu LJ, Brownell KD. A test of different menu labeling presentations. *Appetite*. 2012;59(3):770–7.
- 33 Roberto CA, Kawachi I. Use of psychology and behavioral economics to promote healthy eating. *Am J Prev Med*. 2014;47(6):832–7.
- 34 Thorndike AN, Sonnenberg L, Riis J, Barraclough S, Levy DE. A 2-phase labeling and choice architecture intervention to improve healthy food and beverage choices. *Am J Public Health*. 2012;102(3):527–33.



## Queries

1. Paragraph beginning “A set of,” please verify that the edited version of the information in parentheses, which you changed at the last stage, is correct or reword as needed.
2. Paragraph beginning “Fourth, some,” sentence beginning “Our study,” at the last stage we asked you to add at least one citation to the other studies, renumbering subsequent notes as needed in the text and in the notes section. One author apparently added a callout to Note 20 there, and another apparently then deleted it. Please now add at least one citation to the other studies.
3. “Conclusion,” please verify that the edited version of the language you added at the last stage is correct or reword as needed to clarify the point.