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Abstract

This study uses survey data to analyze the association between restaurant menu label use and total and source-specific daily caloric intakes among U.S. adults age 20 and older who saw nutrition information on a menu the last time they visited a fast-food or sit-down restaurant. Findings show that survey respondents who report seeing and using restaurant menu labels consume significantly fewer total calories per day than do respondents who report seeing the labels but not using them. Fast-food and sit-down restaurant menu label uses are both significantly associated with lower total daily caloric intake, and the associations are estimated to be of similar magnitudes. Findings also suggest that the total daily calorie consumption difference between restaurant menu label users and nonusers may be partly attributable to restaurant menu label users' lower intake of calories from restaurants that post nutrition information on menus. Taken together, these results suggest that nutrition information on restaurant menus may be helping some consumers to align their food orders according to their demand for lower calories which, in turn, is also helping them to keep their total daily caloric intake lower relative to consumers who see but do not use the information.

Keywords: Menu labeling, calorie labeling, restaurant menu, chain restaurant, food choice, source of food, calorie information, nutrition information

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Brandon Restrepo and Travis Minor are agricultural economists with USDA's Economic Research Service. Janet Peckham is an economist with the U.S. Food and Drug Administration.

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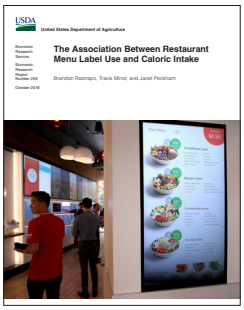

The Association Between Restaurant Menu Label Use and Caloric Intake

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What Is the Issue?

In 2014, the U.S. Food and Drug Administration finalized the Federal menu-labeling regulations that were set forth in the Patient Protection and Affordable Care Act of 2010. These regulations, which took effect in May 2018, require certain restaurants and retail food service establishments that are part of a chain of 20 or more locations nationwide to post the calorie content of all standard items on menus in a font and format similar to that of the item's price or name. Between 2008 and 2011, several State and local governments implemented mandatory menu-labeling regulations. Numerous studies have examined whether the increased availability of calorie information in chain restaurants resulting from these regulations induced consumers to purchase fewer calories than they might have without the information. However, much less is known about whether and how much the average daily caloric intake of individuals who recently *saw and used* menu labels differs from that of individuals who *saw but chose not to use* them. Individuals who see nutrition information on restaurant menus may find the information to be useful for calorie consumption decisions not only inside that restaurant setting but also for managing their calorie intake later in the day at home or in other food service establishments. This study compares the average total and source-specific daily caloric intakes of adults who saw nutrition information about foods on a menu during their last visit to a restaurant and then used the information to decide which foods to buy ("users") with that of an arguably comparable group of adults, those who noticed the information but chose not to use it ("nonusers"). These individuals make up a policy-relevant subpopulation as they were recently in a position to inform their food choices with nutrition information observed in a real-world restaurant setting.

What Did the Study Find?

During 2007-14, about 29 percent of U.S. adults age 20 and older who reported buying food from fast-food or pizza places ("fast-food restaurant") in the past 12 months saw nutrition information about foods on a menu during their last visit to a fast-food restaurant.

- About 44 percent of the individuals who saw menu labels in fast-food restaurants reported using the nutrition information provided to decide which foods to buy during that last visit.

Based on data from two self-reported, nonconsecutive, 24-hour dietary recall interviews, when total and source-specific 2-day mean daily calorie intakes were compared among the adults who saw menu labels in fast-food restaurants at some point in the past 12 months:

- Fast-food restaurant menu-label users consumed about 180 fewer total calories per day than did nonusers.

- Furthermore, among individuals who reported eating fast food during at least one of their dietary recall periods, those who used menu labels consumed about 69 fewer fast-food calories than did nonusers.
- To the extent that recent use of fast-food menu labels reflects typical behavior, these findings suggest that the total daily energy intake gap between fast-food restaurant menu-label users and nonusers may be partly attributable to food choices made in fast-food restaurants that post nutrition information on menus.

During 2007-14, about 22 percent of U.S. adults age 20 and older who reported eating at a restaurant with waiter or waitress service ("sit-down restaurant") in the previous 12 months saw nutrition information about foods on a menu during their last visit to a sit-down restaurant.

- About 48 percent of the individuals who saw menu labels in sit-down restaurants reported using the nutrition information provided to decide which foods to buy during that last visit.

Based on data from two self-reported, nonconsecutive, 24-hour dietary recall interviews, when total and source-specific 2-day mean daily calorie intakes were compared among the adults who saw menu labels in sit-down restaurants at some point in the past 12 months:

- Sit-down restaurant menu label users consumed about 167 fewer total calories per day than did nonusers.
- Furthermore, among individuals who ate food at sit-down restaurants during at least one of their dietary recall periods, those who used menu labels consumed about 99 fewer sit-down-restaurant calories than did nonusers.
- To the extent that recent use of sit-down menu labels reflects typical behavior, these findings suggest that the total daily energy intake gap between sit-down restaurant menu label users and nonusers may be partly attributable to food choices made in sit-down restaurants that post nutrition information on menus.

Fast-food and sit-down restaurant menu label uses are both significantly associated with lower total daily caloric intake, and the associations are estimated to be of similar magnitudes. Findings also suggest that the total daily intake gap between restaurant menu label users and nonusers may be partly attributable to restaurant menu label users' lower intake of calories from restaurants that post nutrition information on menus. Taken together, these findings suggest that nutrition information on restaurant menus may be helping some consumers to align their food orders according to their demand for lower calories which, in turn, is also helping them to keep their total daily caloric intake lower relative to consumers who see but do not use the information.

How Was the Study Conducted?

This study uses data from the only nationally representative survey containing information on consumer use of point-of-purchase nutrition information on fast-food and sit-down restaurant menus: The National Health and Nutrition Examination Survey (NHANES), which is conducted by the Centers for Disease Control and Prevention's National Center for Health Statistics. Specifically, the study uses data from the 2007-08, 2009-10, and 2013-14 cycles of the Flexible Consumer Behavior Survey module of NHANES. These cycles span the period over which several State and local restaurant menu-labeling regulations were implemented. Since calorie intake on a single day provides only a snapshot of consumers' dietary behavior, the analysis made use of average intakes from two self-reported, nonconsecutive, 24-hour dietary recall interviews in an effort to estimate their usual, or long-run, daily caloric intake. Ordinary least squares regressions were used to analyze the association between restaurant menu-label use and total and source-specific 2-day mean daily caloric intakes among U.S. adults who saw nutrition information on a restaurant menu the last time they visited a restaurant. The daily caloric intakes of restaurant menu label users and nonusers were estimated while controlling for demographic and socioeconomic characteristics, as well as interview-related factors (e.g., whether an adult's calorie intake information refers to a weekday or weekend). Of note is that the empirical strategy did not exploit a random source of variation in the availability of nutrition information on point-of-purchase menus, so the regression coefficient estimates reported here do not necessarily represent causal relationships running from restaurant menu label use to total daily caloric intake.

The Association Between Restaurant Menu Label Use and Caloric Intake

Introduction

Adult obesity has been on the rise in the United States since 1980, resulting in the implementation of a wide variety of anti-obesity policies (Cawley, 2016; Cawley and Wen, 2017). While some evidence points to a slowdown in obesity's growth rate (Flegal et al., 2012), the condition currently affects nearly two in five U.S. adults (Hales et al., 2017). It has been suggested that increased caloric intake alone is sufficient to explain the obesity epidemic among U.S. adults (Swinburn et al., 2009).

Numerous nutrition policy initiatives have been launched in the United States to help consumers make better informed decisions on calorie consumption. Since 1994, the U.S. Food and Drug Administration (FDA) has mandated that food manufacturers provide nutrition information on the labels of packaged food products. However, foods sold or served in restaurants have been largely exempted from mandatory nutrition-labeling requirements. In recent years, interest in policies designed to improve point-of-purchase access to nutrition information in food-away-from-home (FAFH) establishments has grown as the share of daily calories coming from FAFH has steadily increased over the past three decades. Between 2008 and 2011, several localities and States implemented mandatory restaurant menu-labeling regulations. And, in an effort to promote uniformity in access to nutrition information at the point of purchase in FAFH establishments across the United States, in 2014, the FDA finalized the Federal menu-labeling regulations that were set forth in the Patient Protection and Affordable Care Act of 2010. These regulations, which took effect in May 2018, require certain restaurants and retail food service establishments that are part of a chain of 20 or more locations nationwide to post the calorie content of all standard items on menus in a font and format similar to that of the item's price or name.

This study draws on the only nationally representative survey containing information on consumer use of point-of-purchase nutrition information on restaurant menus to make a twofold contribution to the literature. First, using data on U.S. adults age 20 and older from the 2007-08, 2009-10, and 2013-14 cycles of the Flexible Consumer Behavior Survey (FCBS) module of the National Health and Nutrition Examination Survey (NHANES), and controlling for demographic and socioeconomic characteristics as well as interview-related factors, this study estimates the association between restaurant menu label use and total caloric intake among consumers who saw nutrition information on a restaurant menu the last time they visited a restaurant. Second, the rich data set used in this study allows researchers to explore the food sources that may explain differences in the total caloric intakes between restaurant menu label users and nonusers. Thus, the study provides an analysis of heterogeneity in the association between restaurant menu label use and caloric intake by food source. The analysis does not establish causality running from restaurant menu label use to caloric intake. Instead, it sheds light on the extent to which restaurant menu label use and caloric intake are associated with one another, separate from demographic and socioeconomic characteristics as well as interview-related factors.

Related Research

The Nutrition Labeling and Education Act (NLEA) of 1990 mandated that food manufacturers disclose the number of calories per serving and other nutrition information in a Nutrition Facts panel (NFP) on packaged food products. A recent study showed that implementation of NLEA regulations was followed by an increase in fiber and iron intakes among NFP label users relative to nonusers (Variyam, 2008). In a systematic review of the nutrition labeling literature, Campos et al. (2011) concluded that there was sufficient evidence that providing consumers with nutrition information on packaged food products helps to improve the quality of their diets.

While the increased availability of nutrition information about packaged foods appears to have resulted in some dietary improvements, producers of FAFH were largely exempted from NLEA regulations. Concern over the lack of readily accessible nutrition information in most FAFH establishments has grown since NLEA regulations were implemented as the size of the FAFH market has expanded dramatically during the period. FAFH spending as a share of total food spending has increased over the last 30 years and, in 2014, for the first time ever, exceeded the share for spending on food at home (FAH) (Saksena et al., 2018). The rise in FAFH expenditures has been accompanied by a rise in caloric intake attributed to dining out: FAFH as a share of total caloric intake rose from about 18 percent in 1977-78 to about 32 percent in 2005-08 (Lin and Guthrie, 2012). These trends have implications for diet quality. Substituting an FAFH meal for an FAH meal is estimated to increase total daily intake among adults by about 134 calories—or about 7 percent for those on a 2,000-calorie-per-day diet (Todd et al., 2010).

Some restaurants have been voluntarily providing nutrition information to customers since the early 1990s, and these efforts have grown over time. In 1994, about 35 percent of the 400 largest chain restaurants made nutrition information for standard menu items available to their patrons (Almanza et al., 1997); by 2004, availability of nutrition information among the largest 300 chain restaurants was estimated at about 54 percent (Wootan and Osborn, 2006). However, even if nutrition information is available for consumers to use while they decide what to order, it can still be costly to access nutrition information while on the premises if the information is not prominently displayed on menus. For example, in 2004, researchers visited 29 of 33 of the McDonald's outlets in Washington, DC, and had to ask 2 or more employees for a copy of the in-store information in 62 percent of the outlets they visited (Wootan et al., 2006). Of the McDonald's outlets that provided in-store nutrition information to restaurant patrons, none posted information on restaurant menus; instead, it was listed on tray liners, pamphlets, posters, or one-page charts. An observational study published in 2009 found that only a small number of chain restaurant patrons—6 of 4,311 patrons at McDonald's, Burger King, Starbucks, and Au Bon Pain—accessed onsite nutrition information that was not present on menus before making a food purchase (Roberto et al., 2009). In another study involving 217 restaurants in the Atlanta, GA, metropolitan area in 2004 and 2005, researchers found that only 5-7 percent of restaurants provided nutrition information on the menu (Saelens et al., 2007).

A consequence of the features of the current retail food market is that consumers often face a gap in access to point-of-purchase nutrition information when purchasing food. While the labeling of packaged food products in stores and supermarkets contains nutrition information that can be used to inform purchases, menus in most FAFH establishments provide little to no nutrition information about food choices. This nutrition information deficit raises concerns among health officials. Prior research has shown that consumers systematically underestimate the calorie content of FAFH

meals, and underestimation tends to be greatest for high-calorie menu items (Robert Wood Johnson Foundation, 2009). Moreover, even well-trained nutrition professionals consistently and substantially underestimate the number of calories in restaurant meals (Backstrand et al., 2009), which suggests that a high level of nutrition knowledge is insufficient for accurately estimating the calories contained in restaurant foods.

If the differences between food choices are clear, such as whether a food is deep fried and accompanied by french fries or is grilled and accompanied by sautéed vegetables, then calorie information may not be necessary for consumers to identify high-calorie options. In fact, a recent ERS study found that when consumers use such dietary rules of thumb, they can readily distinguish between low- and high-calorie menu items; however, the use of observable food characteristics as a tool to estimate calorie content was found to be much less effective for distinguishing between foods that differ only modestly in calorie content (Stewart et al., 2014; Saksena et al., 2018). Nutrients in foods are what economists refer to as "credence attributes," which consumers cannot verify through inspection or consumption (Kuchler et al., 2017). Without the calorie information on hand, consumers dining at FAFH establishments may make food choices that are not optimally aligned with their dietary preferences (Variyam, 2005).

The relative scarcity of nutrition information in FAFH establishments, the concomitant rise in FAFH caloric intake and obesity rates, and evidence that FAFH meals substituted for FAH meals increase daily caloric intake have spurred government initiatives to address the need for point-of-purchase calorie counts on menus in FAFH establishments. As stated earlier, between 2008 and 2011, several localities and States implemented mandatory restaurant menu-labeling regulations that require chain restaurants with 15-20 locations nationwide to provide calorie counts associated with menu items at the point of purchase in an effort to help consumers make better informed food choices.

At present, evidence that menu labeling induces consumers to purchase fewer calories in chain restaurants is mixed (Kiszko et al., 2014; Sinclair et al., 2014; Long et al., 2015; Littlewood et al., 2015; VanEpps et al., 2016a; Fernandes et al., 2016; Bleich et al., 2017). It is important to note, however, that consumers may find the calorie information they observe on restaurant menus useful inside as well as outside of the restaurant setting. Some individuals may use the calorie information they see on restaurant menus to decide what to order on the premises and to inform their calorie consumption decisions later in the day when eating food at home or when purchasing food from other establishments. In a study in which different menu-labeling conditions were randomly assigned to 303 individuals dining out in New Haven, CT, Roberto et al. (2010) found that, relative to those given menus with no calorie counts, those given a menu with calorie counts consumed fewer calories at dinner but reported consuming more calories after dinner, resulting in no statistically significant difference in total caloric intake. James et al. (2015) employed a similar random menu-labeling treatment with 300 students at Texas Christian University and found that, relative to those not given a menu with calorie counts, those given a menu with calorie counts consumed fewer calories during lunch but did not change their consumption habits following the lunch.

While much is known about the degree to which calorie information on restaurant menus affects onsite purchase behavior, relatively little is known about differences in total daily caloric intake between restaurant menu label users and nonusers and the sources of food that may generate such differences. Previous studies suggest that any calorie-reducing effect of restaurant menu labeling may not be sustained for the remainder of the day (Roberto et al., 2010; James et al., 2015), but these analyses are based on small samples and may not generalize to the broader population. This

ERS study aims to fill this gap in the literature with a twofold contribution. First, armed with the only nationally representative survey that contains information on consumer use of point-of-purchase nutrition information in restaurants and 2 days of calorie consumption data, we analyze the association between restaurant menu label use and total daily caloric intake, net of demographic and socioeconomic characteristics as well as interview-related factors. Second, we also analyze for heterogeneity in the association between restaurant menu label use and caloric intake by food source, including fast-food and sit-down restaurants. This approach is motivated by evidence that the impact of menu labeling on purchase and consumption behavior may vary by chain restaurant type (Dumanovsky et al., 2011; Bruemmer et al., 2012; Krieger et al., 2013).

While some localities and States have implemented menu-labeling requirements, Federal menu-labeling regulations that were finalized in 2014 only recently took effect. This study's findings are especially relevant in the current policy context for two reasons. First, they address the question of whether the presence of point-of-purchase nutrition information in food service establishments nationwide may help consumers to regulate their total daily caloric intake. The subpopulation we analyze—those who noticed calorie information on a menu during their last visit to a restaurant—is especially relevant because this group comprises individuals who were recently in a position to use the information to decide what to buy on the premises and perhaps even what to buy and eat later in the day. Second, the findings shed light on whether uses of nutrition information observed in fast-food and sit-down restaurants—the two primary targets of Federal menu-labeling regulations—are equally helpful in regulating total daily caloric intake.

The findings in this study complement those in two recent ERS studies. Using data from the 2007-08 and 2009-10 FCBS module of NHANES, Gregory et al. (2014) found that consumers who see and use nutrition information in restaurants have higher quality diets—as measured by the Healthy Eating Index (HEI)—than those who see but do not use such information. Gregory et al., however, did not estimate the relationship between restaurant menu label use and diet quality separate from other characteristics that differ between menu label users and nonusers. Using data from FoodAPS, Zeballos and Anekwe (2018) employed principal component analysis to construct a "Nutrition Information Use" index, which summarizes a consumer's dietary knowledge and use of NFP labels, and analyzed the association between the index and the HEI scores associated with FAH and FAFH acquisitions. The authors found that the index was positively associated with more healthful FAH acquisitions but was unassociated with the quality of FAFH acquisitions. Regarding the latter finding, it should be noted that the Nutrition Information Use index does not capture nutrition information use in restaurants. This current ERS study builds on these two prior ERS studies by determining whether the primary dietary behavior targeted by restaurant menu-labeling regulations—caloric intake—is associated with the use of nutrition information in fast-food and sit-down restaurants, net of demographic characteristics and socioeconomic characteristics as well as interview-related factors.

Data

In 2007, the ERS-sponsored Flexible Consumer Behavior Survey module was added to the National Health and Nutrition Examination Survey. The FCBS was designed to collect information on U.S. consumers' knowledge, attitudes, and beliefs about nutrition and food choices. This study uses data on adults age 20 and older from the 2007-08, 2009-10, and 2013-14 cycles of NHANES, which provide detailed information on demographic and socioeconomic characteristics, dietary behaviors, and source-specific daily caloric intakes of survey respondents. At the time of this study, these were the only NHANES cycles that provided information on (1) whether respondents have seen and used nutrition information on menus during their last visit to a restaurant and (2) the source of the food respondents reported consuming in the 24-hour period prior to the dietary recall interviews.[1]

Information on calorie consumption was derived from two nonconsecutive, 24-hour dietary recall interviews conducted at a randomly selected interval of 3 to 10 days. Only dietary recall data that were deemed to be reliable by NHANES data analysts were used in the analysis. However, as noted in prior studies, people tend to underreport energy intake during dietary recall interviews (Archer et al., 2013). In addition, because people may answer survey questions based on how they would like to be perceived rather than on how they actually behaved, self-reports of caloric intakes and restaurant menu label use may have been influenced by social desirability concerns (Hebert et al., 1995; Loureiro and Rahmani, 2016). Despite these measurement error issues, scholars have noted that self-report dietary data still possess sufficient signals to inform dietary guidance, diet-related research, and public health policy (Subar et al., 2015).

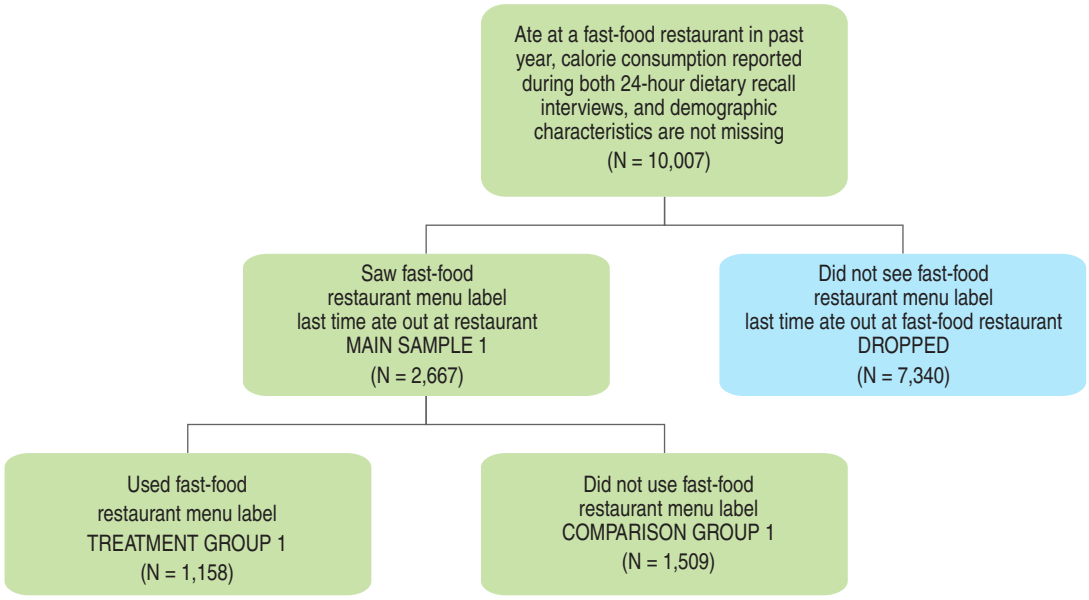
Figure 1 provides an illustration of the sample selection criteria and the questions used to develop the main explanatory variables—fast-food and sit-down restaurant menu label use indicator variables. We restricted our analysis to the sample of respondents who indicated that they saw nutrition information on a menu during their last visit to a restaurant for two reasons. First, we would like to avoid the possibility of mischaracterizing respondents who did not see nutrition information on a menu the last time they visited a restaurant as menu label nonusers. Information on use of a menu label is collected conditional on respondents reporting that they saw nutrition information on a menu during their *last* trip to a restaurant, not *any* past trip to a restaurant. We do not know whether respondents who reported that they did not see nutrition information on a menu the last time they visited a restaurant *never* saw such information and thus have *never* had the opportunity to use such information to decide what to order. Moreover, for those individuals who reported that they did not see nutrition information on a menu the last time they visited a restaurant, we cannot determine whether (a) the information was not there to see (i.e., the establishments were not in a jurisdiction with mandatory menu labeling and did not voluntarily provide nutrition information on their menus) or (b) the respondents did not notice the information. Second, those individuals who see but do not use nutrition information on menus are arguably the best comparison group for those who see and use such information. As noted earlier, including respondents who did not see nutrition information on a menu the last time they visited a restaurant in the analysis would introduce uncertainty about the true composition of the comparison group, as some of these individuals may have seen and used nutrition information on a menu the time before their last restaurant visit and others may have never seen and used such information.

[1] More specifically, while dietary recall data are available in the 2011-12 NHANES cycle, data on whether respondents saw and used nutrition information in restaurants are not available.

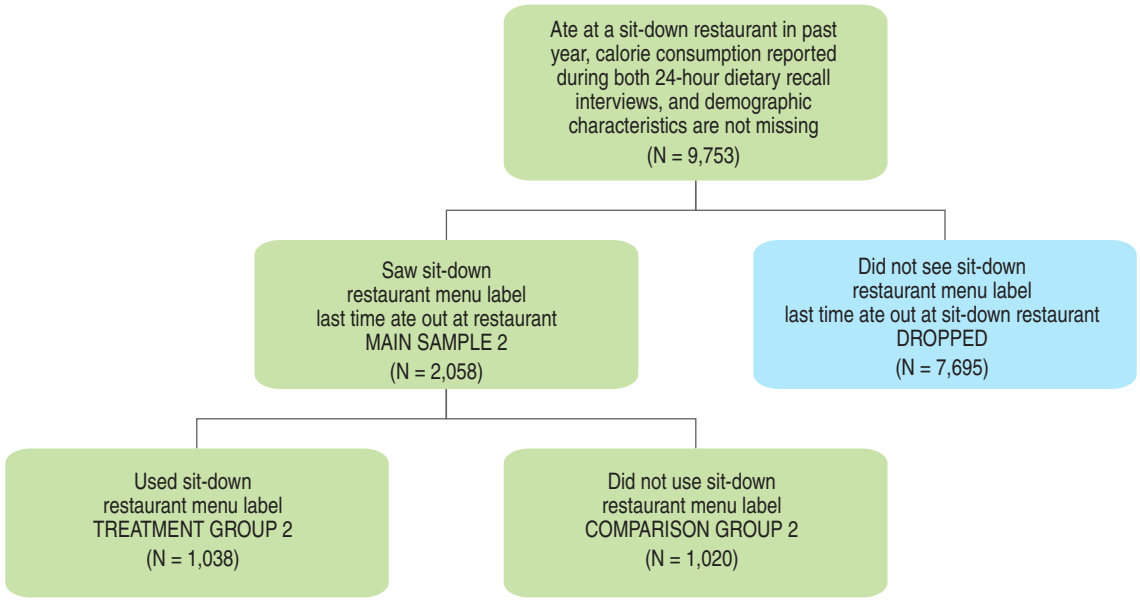
Figure 1

Sample selection criteria

Panel A: Deriving main analysis sample 1



Panel B: Deriving main analysis sample 2



Notes: Main analysis samples 1 and 2 are not mutually exclusive; 1,067 survey respondents are in both samples. Fast-food restaurant menu label use is based on the following question: The last time you ate out or bought food at a fast-food or pizza place, did you see nutrition or health information about any foods on the menu? Sit-down restaurant menu label use is based on the following question: The last time you ate at a restaurant with a waiter or waitress, did you see nutrition or health information about any foods on the menu? For each of these questions, if answered in the affirmative, the respondent is asked the following followup question: Did you use the information in deciding which foods to buy? Our analysis is restricted to survey respondents who saw nutrition or health information on a restaurant menu the last time they ate out at a restaurant.

Source: USDA, Economic Research Service using 2007-08, 2009-10, and 2013-14 cycles of the National Health and Nutrition Examination Survey.

An examination of demographic and socioeconomic characteristics of respondents reveals key differences between those who saw nutrition information on a menu the last time they visited a restaurant and those who did not see such information (app. table 1). For example, men account for 51.3 percent of those who did not see menu labels in fast-food or sit-down restaurants but only 42.4 percent of those who did see a menu label in a sit-down restaurant (p-value < 0.001). Respondents with a bachelor's degree or higher are also significantly more likely to report seeing nutrition information on restaurant menus. These and other significant differences among respondents support the notion that calorie-conscious individuals are more likely to seek out nutrition information on restaurant menus, so the results of our analysis cannot be generalized to the segment of the population that did not see nutrition information on menus the last time they visited a restaurant.

The share of adults who saw nutrition information on fast-food and sit-down restaurant menus more than doubled from 2007-08 to 2013-14 (fig. 2a). Specifically, the share of adults who saw nutrition information on a fast-food restaurant menu increased from 21 percent in 2007-08 to 43 percent in 2013-14. Over the same two periods, the share of adults who saw nutrition information on a sit-down restaurant menu increased from 17 to 32 percent. These statistically significant increases may have been driven, in part, by local and State mandatory menu-labeling regulations that were implemented between 2007 and 2014, as well as by voluntary efforts to improve access to nutrition information at the point of purchase by an increasing share of FAFH establishments.

From 2007-08 to 2013-14, the share of adults who saw and used nutrition information on a fast-food restaurant menu rose from 40 to 45 percent, though this change was not statistically significant (p-value = 0.147) (fig. 2b). In the same period, the share of adults who saw and used nutrition information on a menu at a sit-down restaurant decreased from 52 to 42 percent (p-value = 0.019). Restaurant menu labeling provides information on calories and, thus, may affect consumers' food choices (Bollinger et al., 2011). Once calorie information knowledge is updated by consumers through exposure to restaurant menu labels, they may be better able to decide what to order without using the labels, especially if they generally go to the same restaurants when eating out. Findings suggest that such a "learning effect" (if any) may have been stronger in sit-down restaurants than in fast-food restaurants over the period (see fig. 2b).

Figure 2a

Percentage of adults who saw nutrition or health information on a menu the last time they ate at a restaurant

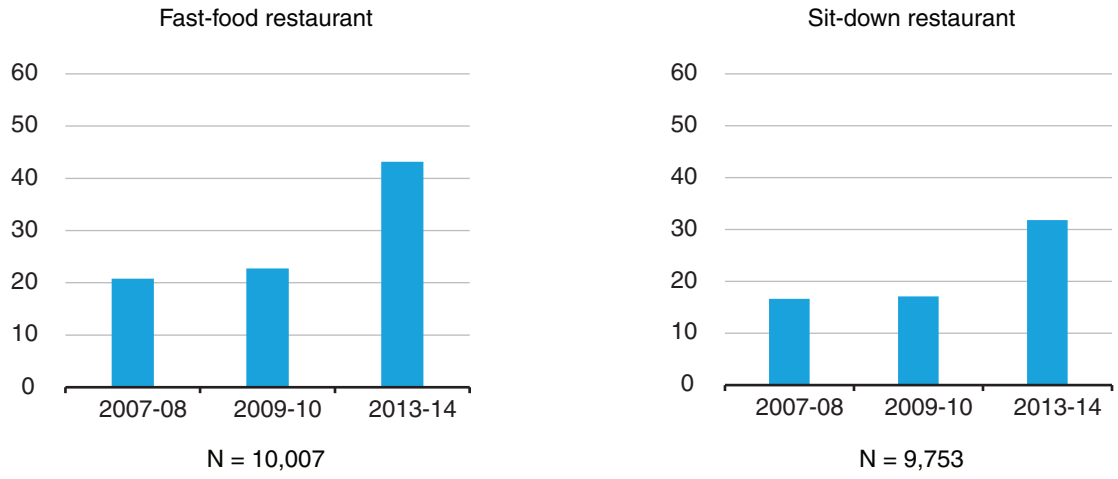
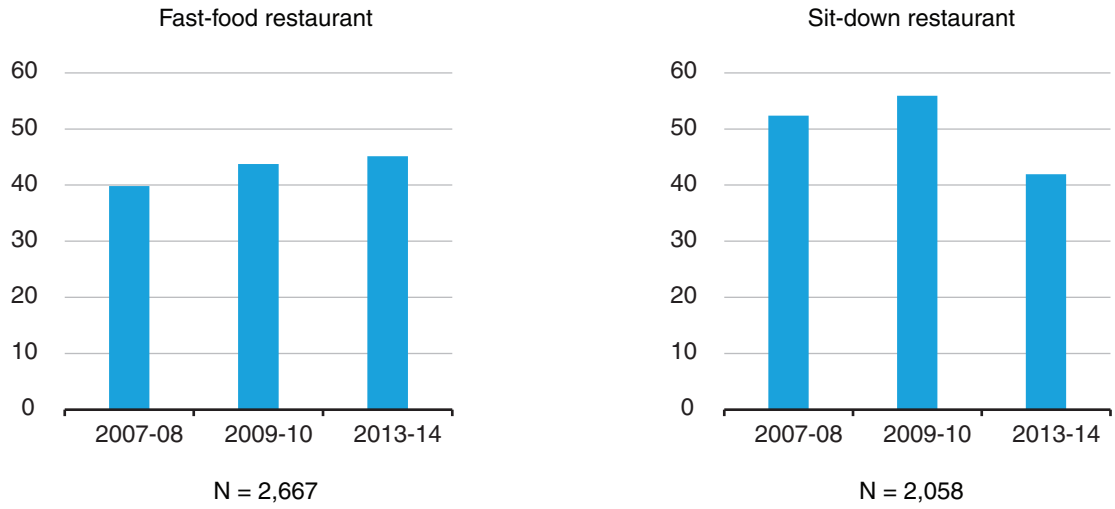


Figure 2b

Among those who saw nutrition or health information on a menu the last time they ate at a restaurant, percentage of adults who used the information to decide what to buy



Note: To get an idea of trends in the percentage of adults in the overall U.S. population who see nutrition information on restaurant menus, figure 2a uses data that were eventually dropped from the analysis samples (see figure 1). In contrast, figure 2b only uses the data from the analysis samples.

Source: USDA, Economic Research Service using 2007-08, 2009-10, and 2013-14 cycles of the National Health and Nutrition Examination Survey.

Methods

Conceptually, we are interested in the association between menu label use and an individual's usual, or long-average, caloric intake. A single day of an individual's caloric intake provides only a snapshot of his or her dietary behavior. Individual caloric intakes vary for a variety of reasons (e.g., day of the week), only some of which can be observed or measured by researchers. The variance of single-day observations of intakes overstates the variance of usual intakes across the population because the single day observation is subject to within-person variation around the long-run average. We use the 2-day mean to reduce this variance, averaging over the two 24-hour dietary recall interviews that were administered to NHANES respondents on nonconsecutive days.[2]

Significant skewness in 2-day mean caloric intakes was observed, so log-transformed dependent variables were used in the regression analysis. In particular, to estimate the association between restaurant menu-label (ML) use and 2-day mean ($2DM_{TotCal}$) calorie consumption, we specified regression models of the form,

$$\ln(2DM_{TotCal_i}) = \alpha_1 + \alpha_2 FF\ ML\ User_i + X_i'\alpha_3 + Z_i'\alpha_4 + \varepsilon_i, \quad (1)$$

$$\ln(2DM_{TotCal_i}) = \beta_1 + \beta_2 SD\ ML\ User_i + X_i'\beta_3 + Z_i'\beta_4 + \varepsilon_i, \quad (2)$$

where $\ln(2DM_{TotCal_i})$ is the natural log of the 2-day mean caloric intake respondent i ($2DM_{TotCal_i} = (Total\ Calories\ on\ day\ 1 + Total\ Calories\ on\ day\ 2)/2$); $FF\ ML\ User_{i\tau}$ and $SD\ ML\ User_{i\tau}$ are indicator variables equal to one if respondent i reported using nutrition information on a fast-food restaurant menu and sit-down restaurant menu, respectively, during his or her last restaurant visit (which may be different from the times that are captured in day 1 or 2 dietary recall interviews); X_i is a vector of individual demographic and socioeconomic characteristics that reduce the risk of confounding the association between restaurant menu label use and caloric intake with other factors; Z_{it} represents a vector of characteristics associated with the interview, including a NHANES 6-month period/cycle fixed-effect; and ε_i is an idiosyncratic error term. α_2 and β_2 are our coefficients of interest in equation 1 and 2, respectively, which represent the estimated associations between menu label use and 2-day mean caloric intake.

We note that the time at which respondents indicated seeing and using nutrition information (i.e., the last time they visited a restaurant) may not correspond to any of the 24-hour dietary recall periods. In 2007-08 and 2009-10, FCBS respondents were asked questions about nutrition information observed on restaurant menus at least 3 days after their day 2 dietary recall interview. In 2013-14, most respondents were asked these FCBS questions before their day 1 dietary recall interview. The time at which nutrition information was observed on a restaurant menu may correspond to a time before, during, or after either of the 24-hour recall periods included in the 2-day mean.

[2] Herrick et al. (2018) describe a method proposed by the National Cancer Institute (NCI) to estimate the distribution of long-run average, or "usual," intakes for assessment of the share of the population with intakes below or above a cutoff. The remaining "between-person" variance of long-run average intakes estimated by the NCI method is smaller than the variance of 2-day means, but the mean was similar across approaches. Herrick et al.'s results suggest that the 2-day "within-person" mean is acceptable if mean intake is of interest. In this report, we use the 2-day mean to estimate the conditional mean of caloric intake (i.e., mean caloric intake given a set of characteristics including restaurant menu label use) via Ordinary Least Squares (OLS). Further adjustment of variance by the NCI method would be important if we were instead interested in estimating quantile regressions (e.g., estimating daily caloric intake at the 10th or 90th percentile of the caloric intake distribution). For our OLS regressions, variance of coefficients may be somewhat overstated, giving our hypothesis tests a conservative bias.

As we discuss in more detail later in this section, in addition to presenting results from the full sample of respondents who saw nutrition information on a menu during their last restaurant visit, we present results from subsamples of respondents whose average caloric intake at a given source is positive (e.g., they usually consume calories from stores, they usually consume calories from fast-food restaurants). The rationale underlying this analysis is that we want to compare restaurant menu label users and nonusers who usually eat a given food source.

The calorie content of foods purchased from different food sources may be labeled in different ways, and the average amount and range of calories contained in meals may vary across food sources. As a consequence, purchase behavior in response to calorie information posted on restaurant menus may vary by food source because of variation in the typical demographic profile of patrons, variation in the amount of nutrition information provided on the menu, variation in the share of low-calorie options on the menu or order in which low-calorie and high-calorie options appear on the menu, or variation in menu design and display more generally (Ellison et al., 2013; Ellison et al., 2014a; Ellison et al., 2014b; Downs et al., 2013; Downs et al., 2015; Thomas, 2015; Streletskaya et al., 2016; VanEpps et al., 2016b). Since the association between restaurant menu label use and calorie consumption may differ by food source, we disaggregated total calories consumed into the calories consumed from a variety of food sources. Also, since we are interested in exploring the potential importance of cross impacts of restaurant menu label use in one setting on calorie consumption in another setting, we separately analyze two samples. All individuals who saw nutrition information on a fast-food restaurant menu (sit-down restaurant menu) are included in main analysis sample 1 (main analysis sample 2).[3]

To estimate the association between restaurant menu label use and source-specific calorie consumption, we specified regression models of the form,

$$\ln(2DM_{Cal_{ij}}) = \gamma_1 + \gamma_2 FF\ ML\ User_i + X_i'\gamma_3 + Z_i'\gamma_4 + \varepsilon_i, \qquad (3)$$

$$\ln(2DM_{Cal_{ij}}) = \delta_1 + \delta_2 SD\ ML\ User_i + X_i'\delta_3 + Z_i'\delta_4 + \varepsilon_i, \qquad (4)$$

where all variables are specified as before, except for our outcome variable, $\ln(2DM_{Cal_{ij}})$, which now represents the natural log of the 2-day mean caloric intake by respondent *i* from food source *j*. We examined calories consumed from five different food sources: *stores*, which include grocery and convenience stores, supermarkets, as well as other stores; *sit-down restaurants*, which refer to restaurants where the respondent was served by a waiter/waitress while seated; *fast-food restaurants*, which include fast-food establishments and pizza places; *other FAFH*, which refers to a combination of other sources of food away from home, such as bars, cafeterias, day care centers, soup kitchens, recreation centers, vending machines, street vendors, among others; and *unknown source*, which captures all other food sources that cannot be linked to a specific food outlet. In appendix table 2, we provide a detailed description of each food source category. γ_2 and δ_2 are our coefficients of interest in equation 3 and equation 4, respectively, which represent the estimated associations between restaurant ML use and source-specific calorie consumption.

To control for demographic and socioeconomic characteristics that may be associated with caloric intake, in the regression analysis, we included in X_{it} variables that measure gender, age as well as its square to account for the quadratic path in caloric intake over the adult life cycle, race/ethnicity,

[3] Note that, as shown in figure 1, main analysis samples 1 and 2 are not mutually exclusive; 1,067 survey respondents are in both samples.

education, marital status, presence of children in the household, number of family members, and a family income index.[4] Because taller individuals tend to consume more energy than shorter individuals, we also included height in X_{it}. Finally, we also control for the following factors (Z_{it}) associated with the time at which survey respondents were interviewed: indicator for day 1 dietary recall being a weekday, indicator for day 2 dietary recall being a weekday, number of days between day 1 dietary recall and household interview, number of days between day 2 dietary recall and household interview, and NHANES 6-month period/cycle indicators. The first two indicators are included to account for any difference in caloric intake between weekdays and weekends. The next two indicator variables are included to account for variance in time between when survey information in the household interview and dietary data are collected. The NHANES 6-month period/cycle indicators are included to control for changes in caloric intakes over time that are common across individuals. The last three variables also help to control for changes in survey design over time.[5]

In all estimations, the primary sampling units, strata, and sampling weights were used to account for the complex sampling design of NHANES. More specifically, summary statistics were weighted and standard errors were adjusted for the complex sampling design using the *svyset* and *svy* prefix to descriptive and regression commands in Stata 14.2. Variance estimates were obtained through Taylor series approximation. We normalized the sampling weights in accordance with NHANES guidance for using multiple cycles. And, since we analyzed subpopulation populations, we used Stata's *subpop* option for survey commands.

[4] The family income index was calculated by NHANES data analysts and is defined as annual family income divided by the poverty threshold specific to the family size, State, and survey year.

[5] As discussed above, one important change in survey design was when the dietary data were collected relative to when the FCBS questions on whether nutrition information was seen in restaurants were asked.

Results

Of the respondents who reported that they saw nutrition information on a menu during their last visit to a fast-food restaurant, 44 percent of them reported using the information to decide what to order (table 1a). About 48 percent of the respondents who reported that they saw nutrition information on a menu during their last visit to a sit-down restaurant reported using the information to decide what to order (table 1b). The average demographic and socioeconomic profile of restaurant menu label users differs from that of nonusers (e.g., menu label users are more likely to be female and to have a bachelor's degree). Models estimated in the analysis adjusted for all the explanatory variables shown in tables 1a and 1b.

Table 1a
Sample summary statistics for respondents who saw fast-food restaurant menu label

	All	Fast-food menu label nonuser	Fast-food menu label user	P-value from test of difference in means
Dependent variables				
Total calories	2,114	2,248	1,941	0.000
	(23)	(33)	(24)	
Store calories	1,402	1,483	1,296	0.000
	(21)	(33)	(24)	
Fast-food calories	313	345	271	0.000
	(18)	(23)	(16)	
Sit-down calories	229	242	212	0.321
	(11)	(17)	(21)	
Other FAFH calories	69	78	57	0.040
	(6)	(9)	(6)	
Unknown source calories	102	101	104	0.764
	(8)	(8)	(12)	
Explanatory variables				
1 if used fast-food restaurant menu label	0.436	--	--	
	(0.015)			
1 if male	0.467	0.542	0.371	0.000
	(0.016)	(0.019)	(0.024)	
Age (years)	45.195	44.310	46.340	0.024
	(0.557)	(0.685)	(0.707)	
1 if Black	0.112	0.121	0.100	0.159
	(0.011)	(0.014)	(0.011)	
1 if Hispanic	0.094	0.085	0.105	0.176
	(0.011)	(0.010)	(0.017)	
1 if other race	0.048	0.043	0.055	0.366
	(0.006)	(0.005)	(0.012)	

—continued

Table 1a

Sample summary statistics for respondents who saw fast-food restaurant menu label—continued

	All	Fast-food menu label nonuser	Fast-food menu label user	P-value from test of difference in means
1 if highest educational attainment is high school	0.181	0.195	0.164	0.111
	(0.017)	(0.023)	(0.015)	
1 if highest educational attainment is some college	0.347	0.367	0.321	0.128
	(0.014)	(0.019)	(0.022)	
1 if highest educational attainment is a bachelor's degree or more	0.381	0.341	0.433	0.001
	(0.019)	(0.020)	(0.026)	
1 if married	0.580	0.558	0.609	0.103
	(0.019)	(0.020)	(0.028)	
1 if cohabitating	0.061	0.073	0.046	0.022
	(0.007)	(0.008)	(0.009)	
1 if children in the household	0.418	0.433	0.398	0.172
	(0.017)	(0.017)	(0.025)	
Number of family members	2.839	2.845	2.830	0.852
	(0.054)	(0.057)	(0.076)	
Family income index	3.035	2.927	3.175	0.004
	(0.072)	(0.080)	(0.084)	
Height (centimeters)	169.606	170.832	168.020	0.000
	(0.329)	(0.384)	(0.464)	
1 if day 1 dietary recall was a weekday	0.702	0.703	0.700	0.920
	(0.015)	(0.023)	(0.021)	
1 if day 2 dietary recall was a weekday	0.712	0.714	0.709	0.864
	(0.017)	(0.020)	(0.022)	
Number of days between day 1 dietary recall and HH interview	15.261	15.204	15.336	0.786
	(0.474)	(0.579)	(0.460)	
Number of days between day 2 dietary recall and HH interview	22.791	22.898	22.653	0.713
	(0.517)	(0.631)	(0.586)	
1 if May 1 through October 31 (2007-08)	0.149	0.163	0.131	0.174
	(0.018)	(0.021)	(0.022)	
1 if November 1 through April 30 (2009-10)	0.106	0.100	0.114	0.458
	(0.017)	(0.017)	(0.021)	

—continued

Table 1a

Sample summary statistics for respondents who saw fast-food restaurant menu label—continued

	All	Fast-food menu label nonuser	Fast-food menu label user	P-value from test of difference in means
1 if May 1 through October 31 (2009-10)	0.141	0.146	0.134	0.403
	(0.022)	(0.019)	(0.027)	
1 if November 1 through April 30 (2013-14)	0.252	0.253	0.251	0.927
	(0.032)	(0.034)	(0.034)	
1 if May 1 through October 31 (2013-14)	0.274	0.258	0.294	0.229
	(0.038)	(0.036)	(0.045)	
Observations	2,667	1,509	1,158	

Notes: Standard errors in parentheses take into account the appropriate National Health and Nutrition Examination Survey sampling weights, strata, and primary sampling units. HH = household. FAFH = food away from home.

Source: USDA, Economic Research Service using 2007-08, 2009-10, and 2013-14 cycles of the National Health and Nutrition Examination Survey.

Table 1b

Sample summary statistics for respondents who saw sit-down restaurant menu label

	All	Sit-down menu label nonuser	Sit-down menu label user	P-value from test of difference in means
Dependent variables				
Total calories	2,072	2,208	1,924	0.000
	(24)	(44)	(28)	
Store calories	1,393	1,426	1,356	0.089
	(23)	(35)	(26)	
Fast-food calories	300	369	224	0.000
	(19)	(33)	(14)	
Sit-down calories	194	217	169	0.079
	(10)	(21)	(11)	
Other FAFH calories	70	75	64	0.384
	(6)	(10)	(7)	
Unknown source calories	116	120	112	0.543
	(7)	(9)	(11)	
Explanatory variables				
1 if used sit-down restaurant menu label	0.478	--	--	
	(0.016)			

—continued

Table 1b

Sample summary statistics for respondents who saw sit-down restaurant menu label—continued

	All	Sit-down menu label nonuser	Sit-down menu label user	P-value from test of difference in means
1 if male	0.424	0.514	0.327	0.000
	(0.015)	(0.028)	(0.021)	
Age (years)	45.225	44.587	45.922	0.201
	(0.587)	(0.787)	(0.766)	
1 if Black	0.135	0.135	0.136	0.891
	(0.014)	(0.015)	(0.016)	
1 if Hispanic	0.097	0.076	0.120	0.014
	(0.010)	(0.013)	(0.013)	
1 if other race	0.054	0.050	0.059	0.491
	(0.007)	(0.009)	(0.010)	
1 if highest educational attainment is high school	0.211	0.239	0.180	0.074
	(0.016)	(0.028)	(0.015)	
1 if highest educational attainment is some college	0.342	0.363	0.318	0.147
	(0.016)	(0.025)	(0.018)	
1 if highest educational attainment is a bachelor's degree or more	0.345	0.286	0.409	0.000
	(0.019)	(0.024)	(0.023)	
1 if married	0.557	0.550	0.563	0.668
	(0.016)	(0.023)	(0.020)	
1 if cohabitating	0.067	0.082	0.052	0.102
	(0.008)	(0.014)	(0.009)	
1 if children in the household	0.415	0.420	0.410	0.739
	(0.017)	(0.024)	(0.020)	
Number of family members	2.850	2.889	2.808	0.378
	(0.059)	(0.078)	(0.072)	
Family income index	2.979	2.937	3.025	0.417
	(0.079)	(0.095)	(0.096)	
Height (centimeters)	168.879	170.463	167.151	0.000
	(0.327)	(0.455)	(0.462)	
1 if day 1 dietary recall was a weekday	0.707	0.700	0.715	0.593
	(0.016)	(0.024)	(0.017)	
1 if day 2 dietary recall was a weekday	0.722	0.723	0.721	0.940
	(0.018)	(0.019)	(0.024)	

—continued

Table 1b
Sample summary statistics for respondents who saw sit-down restaurant menu label—continued

	All	Sit-down menu label nonuser	Sit-down menu label user	P-value from test of difference in means
Number of days between day 1 dietary recall and HH interview	15.320	15.843	14.749	0.157
	(0.490)	(0.647)	(0.584)	
Number of days between day 2 dietary recall and HH interview	23.049	23.468	22.593	0.330
	(0.520)	(0.664)	(0.701)	
1 if May 1 through October 31 (2007-08)	0.150	0.154	0.145	0.697
	(0.019)	(0.026)	(0.018)	
1 if November 1 through April 30 (2009-10)	0.118	0.089	0.150	0.006
	(0.019)	(0.018)	(0.026)	
1 if May 1 through October 31 (2009-10)	0.126	0.118	0.135	0.206
	(0.022)	(0.022)	(0.025)	
1 if November 1 through April 30 (2013-14)	0.254	0.277	0.229	0.210
	(0.038)	(0.045)	(0.040)	
1 if May 1 through October 31 (2013-14)	0.264	0.300	0.226	0.032
	(0.039)	(0.050)	(0.031)	
Observations	2,058	1,020	1,038	

Notes: Standard errors in parentheses take into account the appropriate National Health and Nutrition Examination Survey sampling weights, strata, and primary sampling units. HH = household. FAFH = food away from home.

Source: USDA, Economic Research Service using 2007-08, 2009-10, and 2013-14 cycles of the National Health and Nutrition Examination Survey.

As part of the analysis, we plotted 2-day mean caloric intakes for the full sample, as well as for respondents who saw and used a menu label or who saw and did not use a menu label.[6] Compared with menu label nonusers, menu label users had significantly lower total caloric intake, caloric intake from store foods, and caloric intake from fast-food restaurants (figs. 3a and 3b). These are, however, *unconditional* mean differences. We now turn to estimates of the association between menu label use and caloric intake that are conditional on a comprehensive set of important demographic, socioeconomic, and interview-related characteristics.

[6] Sample means as well as standard errors for these variables can also be found in tables 1a and 1b.

Figure 3a

Two-day mean caloric intake among fast-food restaurant menu label users and nonusers

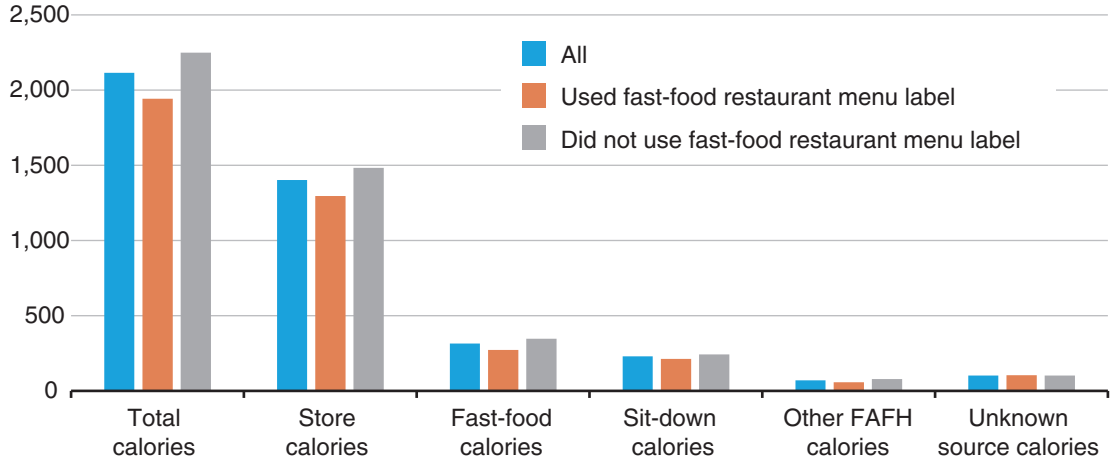
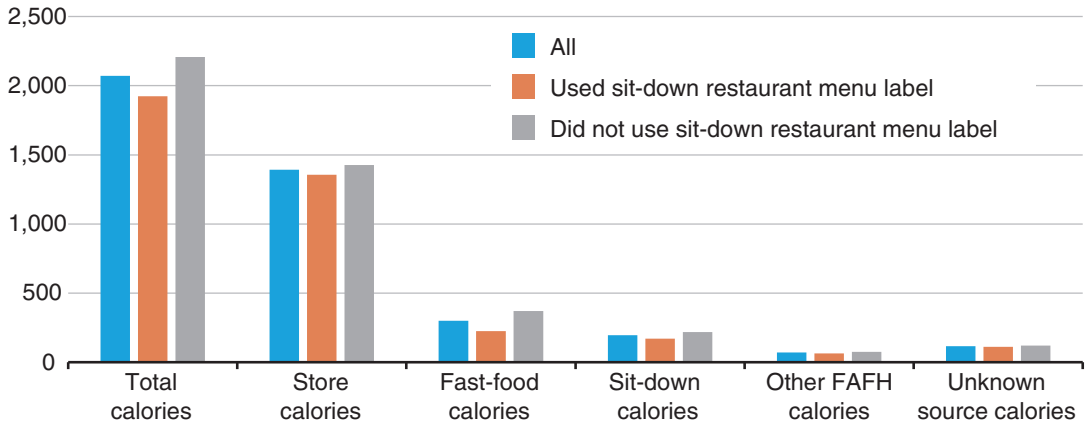


Figure 3b

Two-day mean caloric intake among sit-down restaurant menu label users and nonusers



FAFH = food away from home.

Source: USDA, Economic Research Service using 2007-08, 2009-10, and 2013-14 cycles of the National Health and Nutrition Examination Survey.

Main Sample 1: Respondents Who Saw Nutrition Information on a Fast-Food Restaurant Menu

Table 2 presents coefficient estimates of the association between fast-food restaurant menu label use and 2-day mean caloric intakes. In column 1 of table 2, the results indicate that fast-food menu label users tend to consume 8.5 percent fewer total calories per day than nonusers (*exp*[-0.089]-1), or 180 fewer total calories relative to the sample mean of total caloric intake (8.5%×2,114 calories).

Columns 2-6 of table 2 show results from subsamples consisting of respondents whose 2-day mean caloric intake at a given food source was greater than zero. The results indicate that fast-food menu

label users tend to consume 12.8 percent fewer, or 69 fewer, total calories from fast-food restaurants (column 3). This finding suggests that food choices made in fast-food restaurants may account for some of the difference in the total daily caloric intakes between fast-food menu label users and nonusers. However, we also find that fast-food menu label users tend to consume fewer calories from stores (94), FAFH establishments other than fast-food and sit-down restaurants (103), and other sources (48). Lower caloric intakes at these sources may also explain some of the gap in total daily caloric intake between fast-food menu label users and nonusers.

Table 2
Fast-food restaurant menu label use, total caloric intake, and source-specific caloric intakes

Dep Var (Logged)	(1) Total calories	(2) Store calories	(3) Fast-food calories	(4) Sit-down calories	(5) Other FAFH calories	(6) Unknown source calories
	Full sample	*Subsample of respondents who ate at food source over 2-day recall period*				
Sample means	2,114	1,406	541	580	261	256
1 if fast-food restaurant menu label user	-0.089***	-0.069**	-0.137***	-0.106	-0.501***	-0.209*
	(0.016)	(0.031)	(0.046)	(0.077)	(0.149)	(0.109)
1 if male	0.232***	0.159***	0.237***	0.299***	0.509**	-0.051
	(0.022)	(0.044)	(0.078)	(0.075)	(0.231)	(0.167)
Age	0.003	0.000	0.013	-0.003	-0.016	-0.018
	(0.004)	(0.006)	(0.011)	(0.013)	(0.025)	(0.017)
Age squared	-0.000*	0.000	-0.000*	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
1 if Black	-0.029	-0.059	0.114	-0.149	0.182	-0.226*
	(0.026)	(0.053)	(0.076)	(0.103)	(0.173)	(0.124)
1 if Hispanic	-0.039	-0.031	-0.096	-0.284**	-0.337	0.141
	(0.028)	(0.042)	(0.102)	(0.123)	(0.220)	(0.159)
1 if other race	-0.023	-0.074	0.033	0.056	-1.034*	-0.005
	(0.034)	(0.080)	(0.169)	(0.083)	(0.581)	(0.275)
1 if highest educational attainment is high school	-0.050*	-0.109**	-0.013	-0.065	0.092	-0.212
	(0.030)	(0.042)	(0.081)	(0.145)	(0.350)	(0.195)
1 if highest educational attainment is some college	-0.056**	-0.149***	-0.070	-0.151	0.066	-0.082
	(0.024)	(0.044)	(0.071)	(0.117)	(0.377)	(0.188)
1 if highest educational attainment is a bachelor's degree or more	-0.005	-0.132***	-0.187**	-0.009	0.072	-0.246
	(0.025)	(0.042)	(0.082)	(0.123)	(0.412)	(0.185)
1 if married	-0.004	0.071	0.075	-0.052	-0.243	-0.283*
	(0.020)	(0.047)	(0.086)	(0.085)	(0.159)	(0.147)
1 if cohabitating	0.096**	0.068	0.301***	0.351**	-0.324	-0.365
	(0.039)	(0.081)	(0.104)	(0.145)	(0.364)	(0.294)

—continued

Table 2

Fast-food restaurant menu label use, total caloric intake, and source-specific caloric intakes—continued

Dep Var (Logged)	(1) Total calories	(2) Store calories	(3) Fast-food calories	(4) Sit-down calories	(5) Other FAFH calories	(6) Unknown source calories
	Full sample	*Subsample of respondents who ate at food source over 2-day recall period*				
1 if children in the HH	-0.075**	-0.112*	-0.065	-0.146	0.158	0.256
	(0.028)	(0.061)	(0.111)	(0.100)	(0.173)	(0.168)
Number of family members	0.027**	0.055***	0.020	0.020	0.021	-0.033
	(0.011)	(0.018)	(0.033)	(0.028)	(0.054)	(0.044)
Family income index	0.003	-0.009	-0.072***	0.021	-0.051	0.036
	(0.007)	(0.010)	(0.025)	(0.029)	(0.048)	(0.042)
Height	0.004**	0.005	0.004	-0.002	0.006	0.012
	(0.001)	(0.003)	(0.004)	(0.005)	(0.010)	(0.009)
1 if day 1 dietary recall was a weekday	-0.037**	0.036	-0.078	-0.203***	-0.135	-0.343***
	(0.014)	(0.037)	(0.080)	(0.059)	(0.120)	(0.109)
1 if day 2 dietary recall was a weekday	-0.024	-0.023	-0.054	-0.115**	-0.216	-0.167
	(0.018)	(0.038)	(0.061)	(0.057)	(0.152)	(0.152)
Number of days between day 1 dietary recall and HH interview	0.001	0.001	0.005	-0.009***	0.007	0.000
	(0.001)	(0.002)	(0.004)	(0.003)	(0.011)	(0.008)
Number of days between day 2 dietary recall and HH interview	0.001	0.001	-0.005	0.006**	0.005	-0.008
	(0.001)	(0.002)	(0.004)	(0.002)	(0.006)	(0.008)
1 if May 1 through October 31 (2007-08)	-0.034	0.017	-0.148	0.098	0.442	-0.025
	(0.040)	(0.080)	(0.139)	(0.170)	(0.375)	(0.214)
1 if November 1 through April 30 (2009-10)	-0.024	0.011	-0.200	0.068	0.765**	0.334
	(0.035)	(0.068)	(0.121)	(0.138)	(0.346)	(0.237)
1 if May 1 through October 31 (2009-10)	-0.064*	0.057	-0.240**	-0.091	0.717**	0.002
	(0.037)	(0.079)	(0.118)	(0.123)	(0.276)	(0.205)
1 if November 1 through April 30 (2013-14)	-0.016	-0.093	-0.164	0.134	0.395	0.133
	(0.033)	(0.071)	(0.121)	(0.127)	(0.279)	(0.211)
1 if May 1 through October 31 (2013-14)	-0.035	0.021	-0.312**	0.027	0.241	0.182
	(0.035)	(0.071)	(0.136)	(0.109)	(0.233)	(0.190)
Constant	6.918***	6.230***	5.659***	6.745***	4.096**	3.894**
	(0.241)	(0.524)	(0.654)	(0.900)	(1.857)	(1.597)

—continued

Table 2
Fast-food restaurant menu label use, total caloric intake, and source-specific caloric intakes—continued

Dep Var (Logged)	(1) Total calories	(2) Store calories	(3) Fast-food calories	(4) Sit-down calories	(5) Other FAFH calories	(6) Unknown source calories
	Full sample	*Subsample of respondents who ate at food source over 2-day recall period*				
Observations	2,667	2,661	1,558	958	700	1,088
R-squared	0.218	0.084	0.098	0.120	0.164	0.060

Notes: * denotes statistically significant at the 10-percent level. ** denotes statistically significant at the 5-percent level. *** denotes statistically significant at the 1-percent level. These regression samples include National Health and Nutrition Examination Survey (NHANES) respondents who saw a fast-food restaurant menu label during their last fast-food visit. Columns 2-6 include subsamples of respondents who ate at source indicated in the column and that the composition of these respondents varies by column. Standard errors in parentheses take into account the appropriate NHANES sampling weights, strata, and primary sampling units. HH = household. FAFH = food away from home.

Source: USDA, Economic Research Service using 2007-08, 2009-10, and 2013-14 cycles of the National Health and Nutrition Examination Survey.

Main Sample 2: Respondents Who Saw Nutrition Information on a Sit-Down Restaurant Menu

Table 3 presents coefficient estimates of the association between sit-down restaurant menu label use and 2-day mean caloric intakes. We find that sit-down menu label users tend to consume 8.1 percent fewer, or 167 fewer, total calories than nonusers relative to the sample mean of total daily caloric intake (column 1 of table 3). This is similar to the evidence presented in column 1 of table 2. The associations between use of fast-food and sit-down restaurant menu labels and total daily caloric intake are both economically important and statistically significant.

Turning to the subsamples of respondents with positive 2-day mean caloric intakes at each food source (columns 2-6 of table 3), we find that sit-down menu label use is significantly associated with fewer calories from fast-food restaurants (100), sit-down restaurants (99), and other FAFH establishments (53). These results suggest that the total caloric intake difference between sit-down menu label users and nonusers may be partly explained by food choices that are made in all FAFH establishments, including but not limited to sit-down restaurants.

Table 3
Sit-down restaurant menu label use, total caloric intake, and source-specific caloric intakes

Dep Var (Logged)	(1) Total calories	(2) Store calories	(3) Fast-food calories	(4) Sit-down calories	(5) Other FAFH calories	(6) Unknown source calories
	Full sample	*Subsample of respondents who ate at food source over 2-day recall period*				
Sample means	2,072	1,395	545	537	244	266
1 if sit-down restaurant menu label user	-0.084***	0.027	-0.202**	-0.205***	-0.247*	-0.074
	(0.023)	(0.039)	(0.086)	(0.067)	(0.135)	(0.126)
1 if male	0.301***	0.282***	0.222**	0.108	0.355*	0.418**
	(0.030)	(0.049)	(0.099)	(0.130)	(0.191)	(0.178)
Age	0.006	0.006	-0.004	-0.013	-0.028	-0.023
	(0.005)	(0.009)	(0.014)	(0.016)	(0.023)	(0.021)

—continued

Table 3

Sit-down restaurant menu label use, total caloric intake, and source-specific caloric intakes—continued

Dep Var (Logged)	(1) Total calories	(2) Store calories	(3) Fast-food calories	(4) Sit-down calories	(5) Other FAFH calories	(6) Unknown source calories
	Full sample	*Subsample of respondents who ate at food source over 2-day recall period*				
Age squared	-0.000*	-0.000	-0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
1 if Black	-0.036	-0.118**	0.213**	0.054	0.241	-0.000
	(0.022)	(0.049)	(0.079)	(0.091)	(0.227)	(0.129)
1 if Hispanic	-0.036	-0.081	0.040	-0.175	-0.078	0.066
	(0.034)	(0.070)	(0.122)	(0.112)	(0.206)	(0.180)
1 if other race	0.045	0.028	-0.075	0.080	0.394	-0.464
	(0.034)	(0.113)	(0.269)	(0.145)	(0.249)	(0.329)
1 if highest educational attainment is high school	-0.041	-0.059	-0.143	0.158	-0.263	-0.054
	(0.033)	(0.055)	(0.087)	(0.132)	(0.268)	(0.186)
1 if highest educational attainment is some college	-0.054*	-0.032	-0.340***	0.138	-0.500**	0.020
	(0.027)	(0.061)	(0.091)	(0.133)	(0.242)	(0.173)
1 if highest educational attainment is a bachelor's degree or more	0.002	-0.064	-0.300**	0.165	-0.448	0.012
	(0.030)	(0.076)	(0.116)	(0.142)	(0.272)	(0.201)
1 if married	0.008	0.115	-0.095	0.097	-0.380**	-0.031
	(0.027)	(0.083)	(0.085)	(0.106)	(0.150)	(0.154)
1 if cohabitating	0.084**	0.009	0.198	0.514***	0.129	-0.221
	(0.041)	(0.087)	(0.139)	(0.125)	(0.272)	(0.244)
1 if children in the HH	-0.044	-0.059	-0.014	-0.176*	0.076	0.323**
	(0.036)	(0.064)	(0.119)	(0.101)	(0.228)	(0.137)
Number of family members	0.016	0.048**	0.022	0.011	-0.052	-0.049
	(0.012)	(0.018)	(0.035)	(0.035)	(0.074)	(0.033)
Family income index	-0.010	-0.034*	-0.029	-0.003	-0.005	-0.023
	(0.008)	(0.017)	(0.021)	(0.025)	(0.046)	(0.041)
Height	-0.000	-0.004	0.006	0.009	0.013	-0.007
	(0.001)	(0.004)	(0.004)	(0.005)	(0.011)	(0.008)
1 if day 1 dietary recall was a weekday	-0.028*	-0.005	-0.052	-0.054	0.059	-0.485***
	(0.017)	(0.035)	(0.068)	(0.075)	(0.146)	(0.118)
1 if day 2 dietary recall was a weekday	-0.009	-0.042	0.144**	-0.136	-0.149	-0.149
	(0.022)	(0.049)	(0.064)	(0.083)	(0.190)	(0.126)

—continued

Table 3

Sit-down restaurant menu label use, total caloric intake, and source-specific caloric intakes—continued

Dep Var (Logged)	(1) Total calories	(2) Store calories	(3) Fast-food calories	(4) Sit-down calories	(5) Other FAFH calories	(6) Unknown source calories
	Full sample	*Subsample of respondents who ate at food source over 2-day recall period*				
Number of days between day 1 dietary recall and HH interview	0.001	0.005*	0.002	-0.005	-0.010	-0.008
	(0.001)	(0.003)	(0.004)	(0.005)	(0.009)	(0.010)
Number of days between day 2 dietary recall and HH interview	-0.001	-0.006**	-0.001	0.004	0.006	-0.004
	(0.001)	(0.003)	(0.003)	(0.003)	(0.005)	(0.007)
1 if May 1 through October 31 (2007-08)	0.033	0.065	-0.030	0.044	-0.492	0.058
	(0.045)	(0.072)	(0.162)	(0.106)	(0.294)	(0.445)
1 if November 1 through April 30 (2009-10)	0.001	0.028	0.054	-0.184	0.229	0.480
	(0.048)	(0.057)	(0.097)	(0.116)	(0.240)	(0.436)
1 if May 1 through October 31 (2009-10)	0.020	0.153**	-0.313***	-0.261	0.184	0.075
	(0.049)	(0.058)	(0.113)	(0.187)	(0.158)	(0.469)
1 if November 1 through April 30 (2013-14)	0.001	-0.130	-0.076	-0.080	-0.131	0.047
	(0.042)	(0.078)	(0.110)	(0.130)	(0.213)	(0.418)
1 if May 1 through October 31 (2013-14)	-0.014	0.040	-0.284**	-0.171*	-0.235	0.151
	(0.045)	(0.041)	(0.111)	(0.085)	(0.181)	(0.414)
Constant	7.488***	7.595***	5.552***	5.082***	4.172**	7.070***
	(0.198)	(0.802)	(0.759)	(1.021)	(1.919)	(1.556)
Observations	2,058	2,054	1,135	708	564	855
R-squared	0.216	0.083	0.120	0.125	0.160	0.071

Notes: * denotes statistically significant at the 10-percent level. ** denotes statistically significant at the 5-percent level. *** denotes statistically significant at the 1-percent level. These regression samples include National Health and Nutrition Examination Survey (NHANES) respondents who saw a sit-down restaurant menu label during their last sit-down visit. Columns 2-6 include subsamples of respondents who ate at source indicated in the column and that the composition of these respondents varies by column. Standard errors in parentheses take into account the appropriate NHANES sampling weights, strata, and primary sampling units. HH = household. FAFH = food away from home.

Source: USDA, Economic Research Service using 2007-08, 2009-10, and 2013-14 cycles of the National Health and Nutrition Examination Survey.

Discussion and Interpretation of Findings

Our analysis indicates that, among those who see point-of-purchase nutrition information on restaurant menus, the daily energy intake of individuals who have recently used the information to decide what to order is, on average, significantly lower relative to those who have not used it.[7] Moreover, the analysis suggests that this energy intake gap may be partly determined by lower caloric intakes from the restaurants in which the nutrition information is observed. Taken together, these findings have implications for the public health community and policymakers since they suggest that use of the nutrition information seen on restaurant menus may be helping some consumers to align their orders according to their demand for lower restaurant calories which, in turn, also is also helping them to keep their total daily caloric intake lower relative to other consumers who see but do not use the information. The estimated association between fast-food menu label use and total daily caloric intake is similar in magnitude to the corresponding one between sit-down restaurant menu label use and total daily caloric intake, which suggests that the helpfulness of nutrition information on menus in these two types of restaurant settings for regulating total daily caloric intake may be similar.

It is important to interpret our findings in the context of their limitations. First, our empirical strategy did not exploit an exogenous source of variation in the availability of nutrition information, so our coefficient estimates do not necessarily represent causal relationships. Unmeasurable or unobserved factors associated with seeing and using restaurant menu labels may also be associated with calorie consumption. However, we did control for numerous potentially confounding variables and our conclusions were not sensitive to including them in the regression analysis.

Second, due to the NHANES survey design, it is not possible for the analyst to pinpoint the time at which respondents see nutrition information on restaurant menus and when they purchase food from a variety of food sources. As a consequence, we cannot determine whether the nutrition information seen on a restaurant menu during a respondent's last visit influenced the food choices captured in his or her dietary recall interviews.

Third, our analysis focused on respondents who reported seeing nutrition information on a menu during their last visit to a restaurant. Prior work estimated that about half of the chain restaurant patrons in King County, WA, and New York City, NY, saw calorie information on chain restaurant menus within the first year after local mandatory menu-labeling regulations took effect, but some evidence suggests that the percentage of patrons who notice calorie information falls over time (Chen et al., 2015; Cantor et al., 2015). As noted earlier, our findings may not be representative of the U.S. population, and our data do not allow us to separately estimate short- and longer run associations between menu label use and caloric intake.

[7] Several studies have found that the impact of menu labeling on calorie consumption behavior may not be uniform across individuals (Bollinger et al., 2011; Oh et al., 2015; Sarink et al., 2016; Breck et al., 2014; Green et al., 2015). In an unreported analysis, we examined whether the association of menu label use and caloric intake varies by demographic subgroup (e.g., gender, education, income) but found no significant differences. It is important to note, however, that sample sizes were very small in these subgroup analyses, which limited our ability to detect differences in associations between restaurant menu label use and caloric intake.

Implications for National Menu-Labeling Regulations

The results in this study indicate that, among those who see nutrition information on restaurant menus, total daily calorie consumption tends to be significantly lower among fast-food and sit-down restaurant menu label users. When we exploited data on source-specific caloric intakes, we found that this total caloric intake difference may be partly attributable to restaurant menu label users' lower caloric intake from fast-food and sit-down restaurants, respectively. Federal menu-labeling regulations that became effective in May 2018 impact a large segment of the food service industry. These regulations affect not only meals from restaurants but also foods that are sold or served in grocery and convenience stores, cafeterias, food facilities in entertainment venues, and other retail food outlets. The evidence presented here suggests that the greater presence of point-of-purchase calorie information in food service establishments throughout the United States may help more Americans to achieve their total daily calorie consumption targets. Better informed food purchases in a broader array of food service establishments, coupled with supply-side efforts to reduce the calorie content of foods sold in chain restaurants (Bleich et al., 2015a; Bleich et al., 2015b; Bleich et al., 2016), may increase the potential for restaurant menu labeling to reduce the risk of obesity throughout the Nation (Courtemanche et al., 2016; Deb and Vargas, 2016; Restrepo, 2017).

As we strive to understand the efficacy of the national menu-labeling program that went into effect in May 2018, the findings in this study help us understand how a subsample of NHANES survey respondents—those who recently noticed nutrition information on restaurant menus—may have altered their behavior when they were faced with new nutrition information in restaurant settings. This information is now nationally available in certain chain restaurants, so it may be that the patterns observed here will be broadcast to a wider population, changing dietary patterns across the United States. This study can be viewed as a template for issues that may soon be visible on a national level and provides some indication of effects that may be felt, and what, as researchers, we may be interested in examining in the near future.

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Appendix

Appendix table 1
Differences between respondents who see and do not see menu labels

	(1) Saw fast-food menu label	(2) Saw sit-down menu label	(3) Saw neither fast-food nor sit-down menu label	(4) P-value from test of difference in means (1) v. (3)	(5) P-value from test of difference in means (2) v. (3)
Dependent variables					
Total calories	2,114	2,072	2,158	0.162	0.003
	(23)	(24)	(18)		
Store calories	1,402	1,393	1,472	0.007	0.002
	(21)	(23)	(19)		
Fast-food calories	313	300	267	0.024	0.111
	(18)	(19)	(9)		
Sit-down calories	229	194	223	0.696	0.063
	(11)	(10)	(10)		
Other FAFH calories	69	70	78	0.197	0.362
	(6)	(6)	(5)		
Unknown source calories	102	116	118	0.147	0.833
	(8)	(7)	(6)		
Explanatory variables					
1 if male	0.467	0.424	0.513	0.012	0.000
	(0.016)	(0.015)	(0.008)		
Age (years)	45.195	45.225	46.405	0.074	0.111
	(0.557)	(0.587)	(0.403)		
1 if Black	0.112	0.135	0.092	0.012	0.000
	(0.011)	(0.014)	(0.009)		
1 if Hispanic	0.094	0.097	0.131	0.000	0.003
	(0.011)	(0.010)	(0.014)		
1 if other race	0.048	0.054	0.066	0.053	0.187
	(0.006)	(0.007)	(0.007)		
1 if highest educational attainment is high school	0.181	0.211	0.233	0.011	0.236
	(0.017)	(0.016)	(0.009)		
1 if highest educational attainment is some college	0.347	0.342	0.323	0.155	0.330
	(0.014)	(0.016)	(0.010)		
1 if highest educational attainment is a bachelor's degree or more	0.381	0.345	0.292	0.000	0.021
	(0.019)	(0.019)	(0.014)		

—continued

Appendix table 1

Differences between respondents who see and do not see menu labels—continued

	(1) Saw fast-food menu label	(2) Saw sit-down menu label	(3) Saw neither fast-food nor sit-down menu label	(4) P-value from test of difference in means (1) v. (3)	(5) P-value from test of difference in means (2) v. (3)
1 if married	0.580	0.557	0.581	0.959	0.151
	(0.019)	(0.016)	(0.013)		
1 if cohabitating	0.061	0.067	0.064	0.613	0.714
	(0.007)	(0.008)	(0.004)		
1 if children in the household	0.418	0.415	0.387	0.060	0.120
	(0.017)	(0.017)	(0.010)		
Number of family members	2.839	2.850	2.818	0.670	0.572
	(0.054)	(0.059)	(0.041)		
Family income index	3.035	2.979	2.813	0.000	0.013
	(0.072)	(0.079)	(0.059)		
Height (centimeters)	169.606	168.879	169.391	0.523	0.146
	(0.329)	(0.327)	(0.171)		
1 if day 1 dietary recall was a weekday	0.702	0.707	0.698	0.799	0.560
	(0.015)	(0.016)	(0.010)		
1 if day 2 dietary recall was a weekday	0.712	0.722	0.690	0.199	0.101
	(0.017)	(0.018)	(0.010)		
Number of days between day 1 dietary recall and HH interview	15.261	15.320	15.054	0.634	0.491
	(0.474)	(0.490)	(0.378)		
Number of days between day 2 dietary recall and HH interview	22.791	23.049	23.506	0.219	0.383
	(0.517)	(0.520)	(0.471)		
1 if May 1 through October 31 (2007-08)	0.149	0.150	0.238	0.000	0.000
	(0.018)	(0.019)	(0.030)		
1 if November 1 through April 30 (2009-10)	0.106	0.118	0.134	0.032	0.292
	(0.017)	(0.019)	(0.020)		
1 if May 1 through October 31 (2009-10)	0.141	0.126	0.229	0.000	0.000
	(0.022)	(0.022)	(0.030)		
1 if November 1 through April 30 (2013-14)	0.252	0.254	0.114	0.000	0.000
	(0.032)	(0.038)	(0.018)		

—continued

Appendix table 1

Differences between respondents who see and do not see menu labels—continued

	(1) Saw fast-food menu label	(2) Saw sit-down menu label	(3) Saw neither fast-food nor sit-down menu label	(4) P-value from test of difference in means (1) v. (3)	(5) P-value from test of difference in means (2) v. (3)
1 if May 1 through October 31 (2013-14)	0.274	0.264	0.149	0.000	0.000
	(0.038)	(0.039)	(0.023)		
Observations	2,667	2,058	5,522		

Standard errors in parentheses take into account the appropriate National Health and Nutrition Examination Survey sampling weights, strata, and primary sampling units. HH = houshold. FAFH = food away from home

Source: USDA, Economic Research Service using 2007-08, 2009-10, and 2013-14 cycles of the National Health and Nutrition Examination Survey.

Appendix table 2

Food source category definitions

Food source category	Description of food source
Store	Store - grocery/supermarket
	Store - convenience type
	Store - no additional info
Fast-food restaurant	Restaurant fast food/pizza
Sit-down restaurant	Restaurant with waiter/waitress
Other food-away-from-home source	Bar/tavern/lounge
	Restaurant, no additional information
	Cafeteria, not at school
	Cafeteria, at school
	Child care center
	Family/adult day care center
	Soup kitchen/shelter/food pantry
	Meals on wheels program
	Community food program - other
	Community program, no additional information
	Vending machine
	Common coffee pot or snack tray
	Residential dining facility
	Sport, recreation, or entertainment
	Street vendor, vending truck
	Fundraiser sales
Unknown source	From someone else/gift
	Mail order purchase
	Grown or caught by you or someone you know
	Fish caught by you or someone you know
	Other, specify
	Don't know