

**Appendix Text 1.** Identifying correct labeling status for products included in analysis

We classified products as prepared foods (i.e., subject to the new calorie labeling requirement) if Guiding Stars designated the product as being subject to the new calorie labeling requirement. Our review of the data indicated some misclassifications errors of prepared status in the Guiding Stars data. Thus, we recoded some products' status as a prepared (i.e., labeled) food based on information provided to us by Guiding Stars and product websites. Specifically, we implemented the following quality control checks to ascertain prepared status for products included in the analyses:

First, we identified all product subcategories (small groups of similar products, e.g., bulk cookies or fried chicken – hot) that contained at least one product identified by Guiding Stars as being labeled. We reviewed this list to identify subcategories that could contain false positives (i.e., products marked as prepared in the Guiding Stars data but not actually subject to the new labeling requirement). We identified the following types of subcategories as potentially containing false positives: subcategories with ingredients (e.g., cake ingredients, baking chocolate, olive oils) that may include products unlikely to be sold to costumers directly; subcategories potentially containing packaged (i.e., not prepared) products (e.g., herbs packaged, canned ham); and subcategories with a diverse set of products necessitating review of individual items (e.g., misc deli, gluten free). Then, 2 members of the study team independently reviewed all products in each of these subcategories to determine whether the products were appropriately coded as prepared or packaged, with disagreements resolved by discussion.

Next, we reviewed the product descriptions of most products included in the analytic sample. This process was implemented in 2 phases. First, we reviewed products in our analytic sample that were also sold at one of the supermarket chains for which we also had sales data ( $n=12,310$  unique products, accounting for about 55% of total product-by-timepoint observations in the analytic sample). We began by examining these products because doing so allowed us to identify and prioritize reviewing the prepared status of top-selling products; however, we ultimately checked all products in this subset. Second, we reviewed a subset of the remaining products not sold at the chain for which we had sales data. To identify a feasible subset to review, we examined the subcategories (small groups of similar products) for which we had recoded  $\geq 5\%$  of products in the first stage of review. This yielded an additional 4,862 unique products reviewed. In both phases of the review, one reviewer examined each product and recoded its prepared status based on the rules described below. If the reviewer could not determine the prepared status, a second reviewer also examined the product description. If neither reviewer could resolve the products' prepared status, we retained the original categorization provided in the Guiding Stars database, but flagged the product as having uncertain prepared status; we conducted an additional sensitivity analysis excluding these products from analysis.

Based on our conversations with the Guiding Stars team, we developed the following rules to identify prepared versus packaged products and applied these rules to each stage of review:

- If the product description clearly indicated the product was packaged (i.e., not prepared), we coded the product as packaged (e.g., products described as “canned” or “jarred”, products known to be packaged such as “Kraft deluxe macaroni and cheese”). When we could not discern prepared status from the product description, we searched company

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websites for product images; we coded these products as packaged (unlabeled) or prepared (labeled) based on the image.

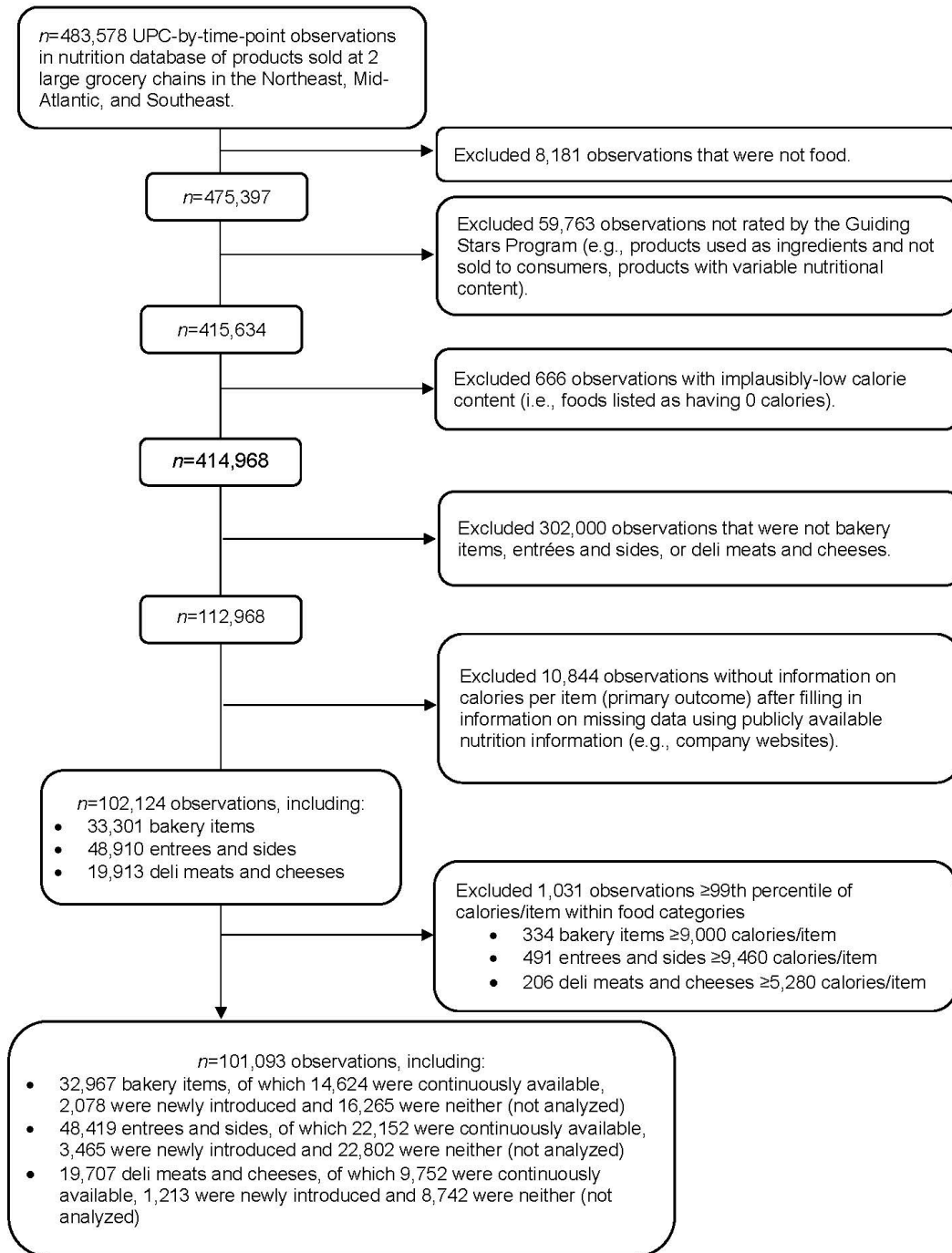
- Products that appeared to be ingredients unlikely to be sold directly to consumers (e.g., “chocolate fudge icing”) were coded as packaged.
- Products that could be sold as ready-to-eat items and that were sold in bulk or by weight (e.g., bulk muffins, hot bar items sold by weight) were coded as prepared.

**Appendix Text 2.** Deviations from pre-registered analysis plan

We preregistered our analysis proposal before conducting analysis (<https://aspredicted.org/blind.php?x=z7dg8j>). The analyses we implemented in the final manuscript differed from what we proposed in three ways. First, we planned to analyze continuously available and newly introduced items in the same models. However, after plotting the pre-implementation trends in calories/item for this combined sample, we observed that calorie content trends differed considerably between continuously available and newly introduced items. We also observed that a large number of prepared products were being introduced at each timepoint and could not distinguish whether changes in calorie content reflected the calorie content of these new products or reformulation of existing products. Thus, we opted to examine continuously available and newly introduced products separately. This decision also follows previous studies of changes in calorie content of restaurant prepared foods before and after calorie labeling implementation.<sup>1-3</sup> Second, we planned to conduct a sensitivity analysis in which we estimated difference-in-difference models that reflected potential differential timing of calorie labeling rollout across products. However, the database did not contain reliable information on the exact timing of labeling implementation for all products. Thus, we opted against an analysis that relied on data on the timing of calorie labeling implementation. Third, we conducted four unplanned sensitivity analyses. One sensitivity analysis excluded products with uncertain prepared status (see Appendix Text 1) to ensure results were robust to potential misclassification of this variable. The second unplanned sensitivity analysis allowed for differential linear time trends in calorie content for prepared vs. comparison bakery items and entrees and sides, instead of assuming a single linear time trend in

these analyses. The third unplanned sensitivity analysis separated changes in outcomes into changes over two periods: after the chains implemented labeling but before the national implementation date (i.e., after April 2017 and before May 2018), and after the national implementation of calorie labeling in May 2018. This analysis helps assess whether observed changes could have been due to implementation of calorie labeling nationally, rather than due to the chains' implementation of labels. Fourth, we examined changes in calorie content of continuously available produce, seafood, and condiments, on the recommendation of a peer reviewer suggesting that we verify that calorie content did not change for these products.

**Appendix Figure 1.** Flow chart of observations included in primary analyses of the primary outcome



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**Appendix Table 1.** Characteristics of Counties With Stores From 1 or Both of the 1 Chains Compared to All U.S. Counties

Characteristic	Counties with stores from chains	All counties
	Mean	Mean
Age, %		
<5 years	5.4%	5.8%
5–9 years	5.7%	6.1%
10–14 years	6.0%	6.4%
15–17 years	3.7%	3.9%
18–24 years	9.3%	8.7%
25–34 years	12.1%	11.8%
35–44 years	11.7%	11.6%
45–54 years	13.4%	12.6%
55–64 years	14.2%	14.2%
65–74 years	10.9%	10.8%
75–84 years	5.5%	5.7%
≥85 years	2.1%	2.3%
Sex, %		
Female	50.8%	50.0%
Male	49.2%	50.0%
Race, %		
White	77.0%	82.5%
Black or African American	16.4%	9.1%
American Indian or Alaska Native	0.6%	1.9%
Asian	1.7%	1.4%
Native Hawaiian or Other Pacific Islander	0.1%	0.1%
Some other race	1.7%	2.5%
2 or more races	2.5%	2.5%
Ethnicity, %		
Not Hispanic or Latino	94.3%	88.4%
Latino or Hispanic	5.7%	11.6%
Educational attainment in population aged ≥25 years, %		

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Less than high school diploma	12.6%	13.4%
High school diploma	61.1%	64.7%
Bachelor's degree or higher	26.3%	22.0%
Annual household income, %		
<\$25,000	22.0%	24.5%
\$25,000–\$49,999	23.4%	24.6%
\$50,000–\$74,999	18.0%	18.2%
\$75,000–\$99,999	12.7%	12.3%
≥\$100,000	23.8%	20.4%

*Note:* Table presents unweighted average characteristics (e.g., average proportion of the population under age 5 years) for counties with stores from 1 or both of the 2 chains examined in this study (column 2) and for all U.S. counties (column 3). Data on county characteristics are from the American Community Survey (ACS) 2019 5-Year Estimates.<sup>4</sup>



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**Appendix Table 2.** Types of Foods Analyzed

<b>Group</b>	<b>Description</b>	<b>Operationalization<sup>a</sup></b>
Bakery items	Muffins, pastries, bagels, biscuits, cookies, and rolls	<p>Products in the “Bakery Fresh” super-category <u>or</u> in the “Sweet bread, cake, or cookie” food group, <u>or</u> in the “Bread” food group <u>and</u> one of the following subcategories containing bagel, cookie, donut, muffin, cake, or rolls: “bagels”, “comm all other”, “comm cakes”, “comm cookies”, “comm Danish”, “comm muffins”, “comm pies”, “comm donuts”, “muffins”, “dinner”, “dough biscuit rolls”, and “sub.”</p> <p>Notes:</p> <ul style="list-style-type: none"> <li>• Excluded loaves of bread, which are not in scope for the new calorie labeling regulation</li> <li>• Excluded wraps/tortillas from comparison items because there were no prepared wraps/tortillas in the dataset</li> <li>• Coded waffles and pancakes as entrees</li> </ul>
Entrees and sides	Main course items or side dishes, including rotisserie chicken, sandwiches, chicken wings, pizza, macaroni and cheese, potato salad, and soups	<p>Products in the “Deli,” “HMS” or “HMS commissary” super-categories <u>or</u> in the “Convenience foods – cold” or “Pizza” or “Soup” food groups.</p> <p>Notes:</p> <ul style="list-style-type: none"> <li>• Excluded sauces, condiments, and dressings</li> <li>• Excluded whole vegetables and whole fruits (e.g., olives, okra, tomatoes).</li> <li>• Excluded fruit/vegetable platters</li> <li>• Excluded products that are clearly ingredients from prepared and comparison entrees (e.g., cooking oils)</li> <li>• Excluded uncooked, plain rice and noodles from comparison entrees, because these are staple foods not comparable to ready-to-eat entrees or sides</li> <li>• Excluded desserts (e.g., mousse)</li> </ul>
Deli meats and cheeses	Pre-sliced deli meats such as turkey, ham, or chicken breast; pre-sliced cheeses	<p>Product in the “Deli/meat cheese” or “Fine cheese meat” super-categories <u>or</u> in the “Processed meat” or “Cheese” food groups</p> <p>Notes:</p>

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		<ul style="list-style-type: none"> <li>• Included platters of pre-sliced deli meats and cheeses</li> <li>• Coded sausage as entrees</li> </ul>
Produce	Bulk fruits, bulk vegetables	<p>Products in “East Veg &amp; Pkg salad,” “Vegetables,” “Seasonal fruit,” “Bananas apples xlife,” “fruit,” “melons tom pep trop” or “west coast veg” super-categories.</p> <p>Notes:</p> <ul style="list-style-type: none"> <li>• Coded salad kits as entrees</li> <li>• Excluded products sold as decorations (e.g., ornamental gourds)</li> <li>• Excluded spices and dried herbs</li> </ul>
Seafood	Salmon, tilapia, tuna, other fish fillets or steaks, lobster, crab, clams, oysters, shrimp, crawfish, scallops	<p>Products in the “seafood” super-category.</p> <p>Notes:</p> <ul style="list-style-type: none"> <li>• Coded seafood entrees (e.g., teriyaki salmon, linguine with shrimp and butter sauce) as entrees</li> </ul>
Condiments, dips, and sauces	Ketchup, mustard, salad dressings, marinara sauce, pesto, syrup, cheese dips and spreads, barbeque sauces, cocktail and tartar sauce, other dips	<p>Products in the “condiments, sauces, and salad dressings” food group.</p> <p>Notes:</p> <ul style="list-style-type: none"> <li>• Excluded snack packs (e.g., apple slices and caramel dip, pretzels and hummus), platters with fruit/vegetables and dip</li> <li>• Coded salad kits with dressings as entrees</li> </ul>

<sup>a</sup>Super-categories and subcategories are larger and smaller groups of similar products, respectively, as defined by the retailer. These categories reflect where consumers would typically find an item in the store. Food groups were developed by the research team to reflect nutritionally relevant groups of items.<sup>5,6</sup>

**Appendix Table 3.** Observations With Missing Calorie Information, Before and After Calorie Labeling

Time period	Bakery				Entrees & sides				Deli meats & cheeses			
	Prepared		Comparison		Prepared		Comparison		Prepared		Comparison	
	N	%	N	%	N	%	N	%	N	%	N	%
Before calorie labeling	194	20%	327	5%	122	9%	675	6%	34	9%	812	15%
After calorie labeling	232	24%	323	5%	120	9%	742	7%	36	10%	801	15%

*Note:* Table shows number and percentage of product-by-timepoint observations with missing data on total calories (i.e., calories/item), among items that otherwise would be included in primary analyses (i.e., items that were food, were rated by Guiding Stars, did not have implausibly low calorie content, were in one of the 3 food categories examined, and were continuously available during the study period; see Appendix Figure 1 for a flowchart of exclusions). The study period included data from July 2015 through January 2019; the chains implemented calorie labeling in April 2017.

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**Appendix Table 4.** Total Unique Products and Product-By-Time-Point Observations Included in Primary Analyses of the Primary (Total Calories) and Secondary (Energy Density and Product Size) Outcomes

Outcome	Continuously available items				Newly introduced items	
	Unique products		Total observations		Unique products/total observations	
	Prepared	Comparison	Prepared	Comparison	Prepared	Comparison
<b>Bakery items</b>						
Total calories (calories/item)	165	1,663	1,320	13,304	385	1,693
Energy density (calories/100 grams)	122	1,482	976	11,856	362	1,573
Product size (grams/item)	122	1,482	976	11,856	362	1,573
<b>Entrees &amp; sides</b>						
Total calories (calories/item)	293	2,476	2,344	19,808	899	2,566
Energy density (calories/100 grams)	293	1,972	2,344	15,776	895	2,525
Product size (grams/item)	293	1,972	2,344	15,776	895	2,525
<b>Deli meats &amp; cheeses</b>						
Total calories (calories/item)	79	1,140	632	9,120	66	1,147
Energy density (calories/100 grams)	79	1,103	632	8,824	66	1,070
Product size (grams/item)	79	1,103	632	8,824	66	1,070

*Note:* Table shows sample size for analyses of primary (total calories) and secondary (energy density, product size) outcomes. The study period included data from 8 timepoints between July 2015 through January 2019. Analyses of continuously available items include 8 observations for each product, thus there are more total observations than there are unique products; analyses of newly introduced items include only unique products (i.e., no repeated measures of the same item); thus, the number of unique products is the same as the number of total observations.

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**Appendix Table 5.** Association Between Total Calories and Product Characteristics Prior to Implementation of Calorie Labeling Among Continuously Available Items

<b>Characteristic</b>	<b>Bakery items</b>	<b>Entrees and sides</b>	<b>Deli meats and cheeses</b>
	<b>B (95% CI)</b>	<b>B (95% CI)</b>	<b>B (95% CI)</b>
Prepared food	201.7 (66.6, 336.8)	-63.2 (-156.6, 30.3)	-102.9 (-256.2, 50.4)
Timepoint	0.3 (-0.3, 0.8)	-0.6 (-1.1, -0.2)	-0.02 (-0.3, 0.3)
Prepared X timepoint	1.4 (-0.4, 3.3)	1.4 (-0.03, 2.9)	2.3 (1.0, 3.5)
Constant	1,346.2 (1,305.6, 1,386.8)	835.0 (804.6, 865.4)	949.2 (910.2, 988.3)

*Notes:* Table shows unstandardized regression coefficients (B) and 95% CIs from regressions of total calories (calories/item) on prepared status, timepoint of data (coded continuously), and the interaction between prepared status and timepoint of data. Analyses examined the 4 timepoints of data prior to calorie labeling implementation (July 2015, January 2016, July 2016, and January 2017; the 2 chains implemented calorie labels in April 2017). Analyses estimated linear mixed models to account for repeated observations, treating the intercept as random.

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**Appendix Table 6.** Association Between Calorie Content and Product Characteristics Prior to Implementation of Calorie Labeling Among Newly Introduced Items

<b>Characteristic</b>	<b>Bakery items</b>	<b>Entrees and sides</b>	<b>Deli meats and cheeses</b>
	<b>B (95% CI)</b>	<b>B (95% CI)</b>	<b>B (95% CI)</b>
Prepared food	76.0 (−430.1, 582.1)	420.0 (−10.2, 850.2)	−1,148.7 (−1,982.8, −314.7)
Timepoint	0.0 (−57.2, 57.2)	10.0 (−42.0, 62.0)	40.0 (−18.1, 98.1)
Prepared X timepoint	−18.0 (−172.5, 136.5)	−70.9 (−205.4, 63.7)	420.0 (159.2, 680.7)
Constant	1,280.0 (1,091.0, 1,469.0)	610.0 (436.6, 783.4)	640.0 (448.6, 831.4)

*Notes:* Table shows unstandardized regression coefficients (B) and 95% CIs from median regressions of calorie content (calories/item) on prepared status, timepoint of data (coded continuously), and the interaction between prepared status and timepoint of data.

Analyses examined the 3 timepoints of data prior to calorie labeling implementation for which we could identify newly introduced items (January 2016, July 2016, and January 2017; the 2 chains implemented calorie labels in April 2017).

**Appendix Table 7.** Association of Implementation of Calorie Labeling With Changes in Total Calories Among Continuously Available Prepared Produce, Seafood, and Condiments

<b>Category</b>	<b>Change in total calories/item</b>
	<b>B (95% CI)</b>
Produce, <i>n</i> =589	-3.9 (-29.4, 21.5)
Seafood, <i>n</i> =316	-4.3 (-44.7, 36.1)
Condiments, sauces, and dips, <i>n</i> =1,651	-26.5 (-115.3, 62.3)

*Notes:* *ns* refer to number of unique products. Table shows unstandardized regression coefficients (B) and 95% CIs for difference-in-differences estimates of effect of calorie labeling, comparing change in outcomes from pre- to post-labeling among prepared foods to change over time among comparison foods. Analyses of continuously available items included data from July 2015 through January 2019; the chains implemented calorie labels in April 2017. Analyses estimated linear mixed models to account for repeated observations, treating the intercept as random. Analyses included differential linear time trends for prepared versus comparison items because pre-implementation trends differed by prepared status for produce (*p* for interaction<0.001), seafood (*p* for interaction=0.003), and condiments (*p* for interaction<0.001). Boldface indicates a statistically significant association, *p*<0.05.

**Appendix Table 8.** Association of Calorie Labeling With Changes in Total Calories Among Continuously Available Prepared Bakery Items, Entrees and Sides, and Deli Meats and Cheeses, Sensitivity Analyses

	(1) Fixed effects at product-level	(2) Include outliers in calories/item	(3) Exclude items with uncertain prepared status	(4) Differential linear time trend	(5) Separate chain vs. national labeling dates
Category	B (95% CI)	B (95% CI)	B (95% CI)	B (95% CI)	B (95% CI)
Bakery items, <i>n</i> =1,812	<b>-7.7 (-12.9, -2.5)</b>	6.7 (-87.1, 100.5)	<b>-7.5 (-12.9, -2.2)</b>	<b>-14.0 (-24.7, -3.3)</b>	<b>-10.1 (-16.5, -3.7)</b>
Entrees & sides, <i>n</i> =2,743	2.6 (-1.4, 6.7)	5.6 (-1.9, 13.1)	2.6 (-1.4, 6.7)	-3.5 (-11.8, 4.8)	0.5 (-4.4, 5.5)
Deli meats & cheeses, <i>n</i> =1,170	0.3 (-10.1, 10.7)	0.4 (-9.7, 10.5)	-0.1 (-11.9, 11.7)	-	-0.9 (-11.6, 9.9)

*Notes:* *ns* refer to number of unique products included in primary analyses. Table shows unstandardized regression coefficients (B) and 95% CIs for difference-in-differences estimates of effect of calorie labeling, comparing change in outcomes from pre- to post-labeling among prepared foods to change over time among comparison foods. Analyses of continuously available items included data from July 2015 through January 2019; the chains implemented calorie labels in April 2017. Model 1 included product-level fixed effects to account for time-invariant unobservable product characteristics. Model 2 included outliers in calorie content ( $\geq 99$ th percentile of calories/item within each food category). Model 3 excluded products for which there remained uncertainty in prepared status (see Appendix Text 1 for details). Model 4 included differential time trends for calorie content of prepared versus comparison foods, instead of a single linear time trend. Primary analyses of deli meats and cheeses included differential linear time trends for prepared versus comparison foods, so sensitivity analyses estimated Model 4 for bakery items and entrees & sides only. Model 5 examined changes in outcomes during 2 post-labeling periods: after implementation of labeling at the chains but before national implementation of labels (i.e., after April 2017 and before May 2018), and after implementation of labeling nationally (May 2018 – end of the study period); the coefficient reported in the table is for difference-in-differences of the effect of chain-level calorie labeling. Boldface indicates a statistically significant association,  $p < 0.05$ .



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**Appendix Table 9.** Pre-labeling Characteristics of Newly Introduced Bakery Items, Entrees and Sides, and Deli Meats and Cheeses Sold at 2 Supermarket Chains

Characteristic	Bakery items		Entrees and sides		Deli meats and cheeses	
	Prepared <i>n</i> =160	Comparison <i>n</i> =714	Prepared <i>n</i> =395	Comparison <i>n</i> =893	Prepared <i>n</i> =35	Comparison <i>n</i> =440
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Total calories (calories/item)	1,658 (1,416)	1,399 (773)	1,873 (2,313)	859 (787)	1,339 (1,366)	886 (645)
Energy density (calories/100 grams)	356 (85)	412 (75)	190 (82)	211 (101)	220 (111)	315 (115)
Product size (grams/item)	480 (439)	350 (212)	996 (1,137)	445 (406)	637 (711)	302 (241)

*Notes:* *ns* refer to number of unique products newly introduced during the pre-labeling period (i.e., introduced in January 2016, July 2016, or January 2017; the 2 chains implemented calorie labels in April 2017) included in analyses of the primary outcome (total calories). Analyses of secondary outcomes (energy density and product size) included fewer observations due to missing data on those outcomes; Appendix Table 4 shows the number of unique products included in each analysis.

## APPENDIX REFERENCES

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