



## Calorie changes among food items sold in U.S. convenience stores and pizza restaurant chains from 2013 to 2017

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### ABSTRACT

The aim of this study was to describe trends in calories among food items sold in U.S. convenience stores and pizza restaurant chains from 2013 to 2017 – a period leading up to the implementation of the federal menu labeling mandate. Using data from the MenuStat project, we conducted quantile regression analyses in 2018 to estimate the predicted median per-item calories among menu items available at convenience stores ( $n = 1522$ ) and pizza restaurant chains ( $n = 2085$ ) – two retailers that have been openly resistant to implementing menu labeling – and assessed whether core food items were reformulated during the study period. We also compared calories in food items available for sale on convenience store and pizza restaurant menus to calories in items that were newly added or dropped. We found that leading up to the national menu labeling implementation date, convenience stores showed a significant decreasing trend in median calories of overall menu items (390 kcals in 2013 vs. 334 kcals in 2017,  $p$ -value for trend  $< 0.01$ ) and among appetizers and sides (367 kcals in 2013 vs. 137 kcals in 2017,  $p$ -value for trend = 0.02). Pizza restaurants introduced lower-calorie pizza options in 2017, but no other significant changes in calories were observed. Going forward, it will be important to track calorie changes in convenience stores and pizza restaurant chains as both food establishments represent significant sources of calories for Americans.

### 1. Introduction

To address concerns that consumers lack nutrition information, the 2010 Affordable Care Act included a provision requiring chain restaurants and similar food establishments with twenty or more locations nationwide to post calorie information on menus and menu boards alongside price. This rule, which was delayed on several occasions, was implemented in May 2018 ([Overview of FDA Labeling Requirements for Restaurants, Similar Retail Food Establishments and Vending Machines, 2017](#)). Following the implementation date, the Food and Drug Administration announced it would work with affected establishments to comply with the menu labeling requirements ([FDA, 2019](#)).

Pizza restaurants and convenience stores have been particularly resistant to the menu labeling rule, arguing that they should be excluded and citing unfair burden ([Domino's CEO Pleads for Menu-Labeling Flexibility, 2011](#); [Federal Menu Labeling Requirements Are Back on the Table, 2017](#); [NACS, 2017](#)). Further, the National Association of Convenience Stores ([Lancaster, 2018](#)) and the American Pizza

Community ([Black, 2017](#)), industry trade groups representing convenience stores and pizza restaurants, respectively, have advocated for the Common Sense Nutrition Disclosure Act, which aims to weaken the federal menu labeling rule by limiting the authority of state and local governments to enforce the legislation. The act would allow restaurants to determine the amount of food in one serving (e.g., half of a hamburger) and exempt restaurants in which most orders are placed online (i.e., pizza restaurants) from posting calorie information in their stores. ([H.R. 772 — 115th Congress: Common Sense Nutrition Disclosure Act of 2017, 2018](#)). The Common Sense Nutrition Disclosure Act was introduced in Congress and passed by the U.S. House of Representatives; however, it was never voted on in the Senate ([H.R.772 - Common Sense Nutrition Disclosure Act of 2017, 2018](#)).

The effects of menu labeling on consumer purchases and restaurant sales have been mixed ([Bleich et al., 2017a, 2017b](#); [VanEpps et al., 2016](#)). For example, a 2017 review of 53 studies found some evidence that menu labeling may lower calories purchased at certain types of restaurants and in cafeteria settings ([Bleich et al. 2017a](#)). Others have

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found that while menu labeling increased knowledge of nutrition information, it did not decrease the amount of calories purchased (Tandon et al., 2011). Results from a meta-analysis involving 6 controlled studies in restaurants did not find menu labeling to be associated with a significant reduction in calories ordered (Long et al., 2015). Further, there is evidence that menu labeling could influence population health by encouraging restaurants to reformulate their menu items to be lower in calories. Prior studies of large chain fast food, fast casual, and full service restaurants have shown that restaurants introduced lower calorie menu items and removed higher calorie items in the years leading up to the federal menu labeling mandate (Bleich et al., 2018; Bleich et al., 2015a; Bleich et al., 2015b). Additionally, chain restaurants implementing menu labeling voluntarily have lower calorie counts than restaurants without calorie labels (Bleich et al., 2015b).

Few prior studies have examined the potential impact of the federal menu labeling rule in pizza restaurants and convenience stores. These venues are important given that they make up a growing share of prepared food purchases and are an important source of calories for Americans. In 2016, convenience stores earned \$233 billion in sales, with prepared food accounting for nearly 22% of total sales (Convenience Stores Hit Record In-Store Sales in 2016, 2017). Convenience stores are generally common in low-income neighborhoods (Hilmers et al., 2012) and high accessibility to convenience stores is associated with lower quality diets (Lind et al., 2016; Rummo et al., 2015); they have also been associated with obesity and chronic disease (Powell et al., 2007; Wang and Beydoun, 2007). Pizza restaurants have also experienced growth in sales. In 2017, Pizza Hut and Domino's Pizza experienced increases in gross sales compared to 2016; both popular chains had gross sales of over 14 and 10.5 billion dollars, respectively (2017 Top 100 Pizza Companies 2017). Furthermore, according to national data, 13% of the United States (U.S.) population aged 2 years and older consumes pizza on any given day, with pizza accounting for 27% of caloric intake on days it is consumed (McGuire 2014). Convenience stores and fast-food restaurants are key locations in which youth consume pizza and other foods high in saturated fats (Crepinsek et al. 2009; Poti et al., 2014).

The anticipatory response of pizza restaurants and convenience stores to menu labeling may differ from chain restaurants, which were subject to menu labeling under a patchwork of prior local laws and, thus, supported the federal legislation (Block, 2018). In particular, the persistent efforts of pizza restaurants and convenience stores to seek an exemption to the rule may have muted the menu reformulation that has been consistently observed in large chain restaurants since 2012. The purpose of this paper is to describe trends in calories among food items sold in U.S. convenience stores and pizza restaurant chains from 2013 to 2017 – a period leading up to the highly anticipated implementation of the federal menu labeling mandate.

## 2. Methods

### 2.1. Sample

Our data comes from the MenuStat project (2017), which is a publicly available database containing nutrient information for foods and beverages sold in the nation's largest 66 restaurant and convenience store chains ranked by annual sales (New York City Department of Health and Mental Hygiene 2017). To populate the MenuStat database, item descriptions, nutrients and serving sizes are collected each January from all products appearing on restaurant websites; nutrients are entered per item. Only restaurants that post nutrition information online are available in MenuStat. From 2013 to 2017, websites were used as the primary source of product data, supplemented with data in other formats when available (e.g., PDFs of nutrition information). Items were assigned a unique identifier and matched over time using the item description. Additional methods of the MenuStat project, including its data collection procedures, are

described elsewhere (New York City Department of Health and Mental Hygiene 2017). For the present study, we analyzed food items available for sale from four of the nation's largest convenience store chains (7-Eleven, Casey's General Stores, Wawa, Sheetz) and eight pizza restaurant chains (Domino's, Papa John's International, Little Caesars, Pizza Hut, Papa Murphy's International, CiCi's Pizza, California Pizza Chicken, Chuck E. Cheese's). These specific convenience store and pizza restaurant chains were selected since they sell restaurant-type foods and have nutrition information available in MenuStat. MenuStat includes nutrient data available from 2013 to 2017 (2013 was the first year in which data were available for convenience stores). In 2017, the four convenience stores examined in this study ranked among the top 20 by number of stores nationwide; all eight pizza restaurant chains were ranked in the top 10 (See Supplemental Table 1). Analyses were limited to prepared food categories that would be impacted by the menu labeling rule, which included appetizers and side dishes, main course items, and desserts – all of which are mutually exclusive categories assigned by MenuStat. We also examined sub-categories of main courses, assigned by the MenuStat team (e.g., pizza, sandwiches, salads, soups, entrees). We designated main courses as being central to the restaurant's business if the item category accounted for the majority of main course items on the menu (sandwiches for convenience stores and pizza for pizza chains). Because most beverages sold in these settings were packaged beverages with a Nutrition Facts Label, they were excluded. Data on portion sizes were incomplete in MenuStat and were not analyzed. Menu items missing calorie information in any year, most of which were from convenience stores, were excluded ( $n = 1101$ , 23%). Our final dataset included 3607 items available in convenience stores ( $n = 1522$ ) and pizza restaurants ( $n = 2085$ ).

### 2.2. Statistical analysis

We used quantile regression models (Koenker and Hallock 2001) to estimate the following: 1) the predicted median per-item calories among all menu items available at convenience stores and pizza restaurant chains in each year during the study period (2013, 2014, 2015, 2016, and 2017); 2) the predicted median per-item calorie changes from 2013 to 2017 among popular items available on menus of convenience stores and pizza restaurant chains across all years (reformulation of “core” menu items); 3) the predicted median per-item calories among items available only on the menu in 2013 compared to newly introduced items in 2014, 2015, 2016, and 2017; and 4) the predicted median per-item calories among items on the menu in 2013, 2014, 2015, or 2016 that stayed on the menu through 2017 compared to items dropped from the menu in any subsequent year. Quantile regressions were selected to estimate median values to reduce the influence of a small number of outliers (mainly large, shareable items).

Our primary independent variables in each model were a year indicator, with 2013 as the reference group (models 1 and 2); an indicator for whether a menu item was on the menu only in 2013 (reference) or newly introduced in a subsequent year (model 3); and an indicator for whether the item was on the menu through 2017 (reference) or was dropped from the menu in any year prior to 2017 (model 4). To make inferences about whether certain characteristics of restaurants (e.g., regional vs. national chain status) are associated with changes in calories over time, we did not include restaurant chain as a covariate. In all models, covariates included restaurant type (indicators for whether a restaurant chain was fast food, fast casual, or full service), an indicator for whether the restaurant was national (sold in all nine U.S. census regions) or not, and an indicator for children's menu item status. Children's items were those with “kid,” “child,” or “children” appearing in the menu item or its description. We estimated cluster robust standard errors to account for similarity of menu items within restaurants. Statistical significance for our analyses was established at  $p < 0.05$ . All analyses were conducted using Stata 13 (StataCorp, 2013).

**Table 1**  
Predicted median per-item calorie content (kcal) among items on menus in 2013–2017, by chain type and menu category.

| Menu category             | n    | Median calories 2013 | Median calories, 2014 | Median calories, 2015 | Median calories, 2016 | Median calories, 2017 | p-value for trend |
|---------------------------|------|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-------------------|
| Convenience stores        |      |                      |                       |                       |                       |                       |                   |
| Overall <sup>a</sup>      | 1522 | 390                  | 400                   | 340                   | 380                   | 334                   | < 0.01            |
| Appetizers and sides      | 127  | 367                  | 470                   | 310                   | 303                   | 137                   | 0.02              |
| Main courses <sup>b</sup> | 1150 | 400                  | 400                   | 334                   | 410                   | 340                   | 0.07              |
| Sandwiches                | 865  | 420                  | 420                   | 430                   | 460                   | 380                   | 0.99              |
| All else                  | 285  | 350                  | 351                   | 284                   | 300                   | 300                   | 0.36              |
| Desserts                  | 245  | 380                  | 360                   | 360                   | 340                   | 350                   | 0.15              |
| Pizza restaurants         |      |                      |                       |                       |                       |                       |                   |
| Overall <sup>a</sup>      | 2085 | 255                  | 255                   | 255                   | 245                   | 245                   | 0.52              |
| Appetizers and sides      | 211  | 190                  | 190                   | 183                   | 155                   | 360                   | 0.89              |
| Main courses <sup>b</sup> | 1754 | 280                  | 290                   | 280                   | 267                   | 260                   | 0.31              |
| Pizza                     | 1411 | 280                  | 270                   | 280                   | 260                   | 260                   | 0.27              |
| All else                  | 343  | 293                  | 263                   | 263                   | 263                   | 283                   | 0.99              |
| Desserts <sup>c</sup>     | 120  | 243                  | 219                   | 241                   | 243                   | 213                   | 0.75              |

Notes: Median per-item calories in each year adjusted for children's menu item status, whether a restaurant chain is national, and restaurant type (fast food, full service, fast casual). Standard errors are clustered to account for correlation of items within restaurants.

<sup>a</sup> Includes all menu categories except beverages and toppings/ingredients.

<sup>b</sup> Includes burgers, entrees, pizza, sandwiches, and salads and soups that are not categorized as appetizers or side dishes.

<sup>c</sup> Includes desserts and other baked goods.

### 3. Results

Of 1522 food items on the menu in convenience stores, most were main courses ( $n = 1150$ , 76%), 16% ( $n = 245$ ) were desserts, and 8% ( $n = 127$ ) were appetizers and sides (Supplementary Table 2). At pizza restaurant chains, the majority of the 2085 items were main courses ( $n = 1754$ , 84%), followed by appetizers and sides ( $n = 211$ , 10%) and desserts ( $n = 120$ , 6%).

Table 1 shows median calories among all items on the menu in convenience stores and pizza restaurant chains in each year between 2013 and 2017, overall and by menu item category. Between 2013 and 2017, convenience stores showed a significant decreasing trend in median calories of overall menu items (390 kcals in 2013 vs. 334 kcals in 2017,  $p$ -value for trend < 0.01) and among appetizers and sides (367 kcals in 2013 vs. 137 kcals in 2017,  $p$ -value for trend = 0.02). There were no changes in pizza restaurants during this period.

Items on the menu in each year between 2013 and 2017 ("core" menu items) made up a smaller percentage of menu items in convenience stores ( $n = 112$ ; 7%) compared to pizza restaurants ( $n = 417$ ; 20%), and there were no changes in calories in these items over time in either restaurant type (Table 2). The low percentage of core items at convenience stores may be indicative of many items coming on and off

the menu each year.

Table 3 shows the predicted median calories for food items that appeared on the menu only in 2013 compared to those newly introduced in subsequent years (2014, 2015, 2016, or 2017). At convenience stores, appetizers and sides newly introduced in 2017 contained 219 fewer calories, compared to those available only in 2013 (519 kcals in 2013 vs. 300 kcals in 2017,  $p < 0.01$ ). Additionally, non-sandwich main courses (e.g., pizza, salads, soups) newly introduced in 2017 had 122 fewer calories than those only on the menu in 2013 (423 kcals in 2013 vs. 301 kcals in 2017,  $p = 0.02$ ). At pizza restaurant chains, newly introduced main course items in 2017 had 10 fewer calories compared to those only on the menu in 2013 (270 kcals in 2013 vs. 260 kcals in 2017,  $p = 0.02$ ). This reduction was driven by changes in newly introduced pizzas, which contained 40 fewer calories in 2017 compared to pizzas on the menu only in 2013 (288 kcals in 2013 vs. 248 kcals in 2017,  $p < 0.001$ ).

Table 4 shows the median calories of food items that consistently were on the menu in 2013 or newly introduced and remained on the menu through 2017, compared to those that were on the menu in 2013 or newly introduced and removed from the menu in any subsequent year. In convenience stores, food items dropped from the menu were significantly higher in calories compared to those that remained – a

**Table 2**  
Predicted median per-item calorie content (kcal) among "core" items on menus all years, by chain type and menu category.

| Menu category             | n   | Median calories 2013 | Median calories, 2014 | Median calories, 2015 | Median calories, 2016 | Median calories, 2017 | p-value for trend |
|---------------------------|-----|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-------------------|
| Convenience stores        |     |                      |                       |                       |                       |                       |                   |
| Overall <sup>a</sup>      | 112 | 380                  | 390                   | 400                   | 405                   | 400                   | 0.29              |
| Appetizers and sides      | 16  | 400                  | 470                   | 470                   | 460                   | 420                   | 0.99              |
| Main courses <sup>b</sup> | 50  | 421                  | 421                   | 470                   | 470                   | 460                   | 0.27              |
| Sandwiches                | 19  | 535                  | 535                   | 520                   | 520                   | 515                   | 0.66              |
| All else                  | 31  | 368                  | 387                   | 460                   | 460                   | 460                   | 0.20              |
| Desserts                  | 46  | 350                  | 350                   | 350                   | 360                   | 360                   | 0.28              |
| Pizza restaurants         |     |                      |                       |                       |                       |                       |                   |
| Overall <sup>a</sup>      | 417 | 263                  | 263                   | 271                   | 263                   | 271                   | 0.46              |
| Appetizers and sides      | 10  | 500                  | 490                   | 490                   | 490                   | 490                   | 0.99              |
| Main courses <sup>b</sup> | 378 | 278                  | 280                   | 280                   | 280                   | 280                   | 0.99              |
| Pizza                     | 258 | 274                  | 271                   | 271                   | 264                   | 270                   | 0.71              |
| All else                  | 120 | 280                  | 290                   | 290                   | 290                   | 290                   | 0.99              |
| Desserts <sup>c</sup>     | 29  | 240                  | 240                   | 241                   | 243                   | 243                   | 0.94              |

Notes: Median per-item calories in each year adjusted for children's menu item status, whether a restaurant chain is national, and restaurant type (fast food, full service, fast casual). Standard errors are clustered to account for correlation of items within restaurants.

<sup>a</sup> Includes all menu categories except beverages and toppings/ingredients.

<sup>b</sup> Includes burgers, entrees, pizza, sandwiches, and salads and soups that are not categorized as appetizers or side dishes.

<sup>c</sup> Includes desserts and other baked goods.

**Table 3**

Predicted median per-item calorie content (kcal) among items on the menu only in 2013 versus those newly introduced in 2014, 2015, 2016, and 2017 by chain type and menu category.

| Menu category             | n    | Median calories<br>2013 only | Median calories,<br>new in 2014 | Median calories,<br>new in 2015 | Median calories,<br>new in 2016 | Median calories,<br>new in 2017 | Difference<br>2013–2017 | P-value |
|---------------------------|------|------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|-------------------------|---------|
| Convenience stores        |      |                              |                                 |                                 |                                 |                                 |                         |         |
| Overall <sup>a</sup>      | 894  | 360                          | 380                             | 310                             | 460                             | 340                             | −20                     | 0.21    |
| Appetizers and sides      | 103  | 519                          | 651                             | 260                             | 370                             | 300                             | −219                    | < 0.01  |
| Main courses <sup>b</sup> | 669  | 360                          | 370                             | 284                             | 490                             | 340                             | −20                     | 0.17    |
| Sandwiches                | 479  | 360                          | 380                             | 430                             | 520                             | 360                             | 0                       | 0.99    |
| All else                  | 190  | 423                          | 351                             | 256                             | 320                             | 301                             | −122                    | 0.02    |
| Desserts <sup>c</sup>     | 122  | 390                          | 320                             | 370                             | 400                             | 410                             | 20                      | 0.95    |
| Pizza restaurants         |      |                              |                                 |                                 |                                 |                                 |                         |         |
| Overall <sup>a</sup>      | 1357 | 264                          | 250                             | 264                             | 230                             | 240                             | −24                     | 0.10    |
| Appetizers and sides      | 147  | 785                          | 755                             | 760                             | 720                             | 700                             | −85                     | 0.39    |
| Main courses <sup>b</sup> | 1134 | 270                          | 270                             | 280                             | 250                             | 260                             | −10                     | 0.02    |
| Pizza                     | 969  | 288                          | 258                             | 278                             | 198                             | 248                             | −40                     | < 0.001 |
| All else                  | 165  | 131                          | 131                             | 171                             | 192                             | 261                             | 130                     | 0.65    |
| Desserts <sup>c</sup>     | 122  | 600                          | 315                             | 209                             | 490                             | 280                             | −320                    | 0.08    |

Notes: Median per-item calories in each year adjusted for children's menu item status, whether a restaurant chain is national, and restaurant type (fast food, full service, fast casual). Standard errors are clustered to account for correlation of items within restaurants.

<sup>a</sup> Includes all menu categories except beverages and toppings/ingredients.

<sup>b</sup> Includes burgers, entrees, pizza, sandwiches, and salads and soups that are not categorized as appetizers or side dishes.

<sup>c</sup> Includes desserts and other baked goods.

difference of 60 kcals (340 kcals for items that stayed on the menu vs. 400 kcals for items dropped,  $p < 0.001$ ). This difference was driven by changes in appetizers and sides (260 kcals vs. 460 kcals,  $p < 0.001$ ), main courses (350 kcals vs. 400 kcals,  $p = 0.03$ ), and desserts (330 kcals vs. 390 kcals,  $p < 0.001$ ). There were no significant differences between calories in items that stayed on the menu and items dropped from the menu in pizza restaurants, overall or for any menu item category.

#### 4. Discussion

Our study findings suggest that in the period leading up to the national menu labeling implementation date, convenience stores and pizza restaurant chains reduced calories in menu items, but the magnitude of the reduction varied by menu item category and restaurant type. We saw more changes among convenience stores, which showed a trend towards reducing calories overall, primarily by introducing new, lower-calorie entrees and removing higher-calorie appetizers and sides, entrees, and desserts. We saw no changes in calories among core menu

items (available in all years) in either restaurant type.

These findings are consistent with prior literature among the nation's large chain restaurants, which have reduced calories in menu items in the years leading up to the anticipated implementation of the federal menu labeling mandate (Bleich et al. 2017b). In one study, which examined 19,391 items from 44 chain restaurants, calories per item declined from 2008 to 2015 (Bleich et al., 2017b). Another study, which also used MenuStat data to compare calories among items at national chain restaurants, found restaurants that voluntarily implemented menu labeling offered lower calorie menu items than those that did not (Bleich et al., 2015b). These results suggest restaurants may be responding to the increased transparency by offering lower calorie items to consumers, although these changes may also be part of a larger secular trend that pre-dates the passage of the menu labeling rule in 2010. In our study, only convenience stores demonstrated a slight decreasing trend in calories from 2013 through 2017. We did not observe changes in calories in pizza restaurant chains, possibly because they expected further delays of the federal rule, not to be included in the federal rule, or for the federal rule to not be implemented at all (CSD

**Table 4**

Predicted median per-item calorie content (kcal) among items that stayed on the menu compared to items dropped, by chain type and menu category.

| Menu category             | n    | Median calories, on in 2013, 2014, 2015, or 2016<br>and stayed on | Median calories, on in 2013, 2014, 2015, or<br>2016 and dropped | Difference in calories for items<br>dropped | P-value |
|---------------------------|------|---|---|---|---------|
| Convenience stores        |      |   |   |   |         |
| Overall <sup>a</sup>      | 1245 | 340   | 400   | 60  | < 0.001 |
| Appetizers and sides      | 90   | 260   | 460   | 200   | < 0.001 |
| Main courses <sup>b</sup> | 945  | 350   | 400   | 50  | 0.03    |
| Sandwiches                | 713  | 440   | 420   | −20   | 0.36    |
| All else                  | 232  | 300   | 330   | 30  | 0.69    |
| Desserts <sup>c</sup>     | 210  | 330   | 390   | 60  | < 0.001 |
| Pizza restaurants         |      |   |   |   |         |
| Overall <sup>a</sup>      | 1499 | 300   | 250   | −50   | 0.26    |
| Appetizers and sides      | 154  | 384   | 154   | −230  | 0.69    |
| Main courses <sup>b</sup> | 1265 | 256   | 220   | −36   | 0.42    |
| Pizza                     | 1023 | 280   | 269   | −11   | 0.71    |
| All else                  | 242  | 670   | 650   | −20   | 0.84    |
| Desserts <sup>c</sup>     | 80   | 240   | 160   | −80   | 0.50    |

Notes: Median per-item calories in each year adjusted for children's menu item status, whether a restaurant chain is national, and restaurant type (fast food, full service, fast casual). Standard errors are clustered to account for correlation of items within restaurants.

<sup>a</sup> Includes all menu categories except beverages and toppings/ingredients.

<sup>b</sup> Includes burgers, entrees, pizza, sandwiches, and salads and soups that are not categorized as appetizers or side dishes.

<sup>c</sup> Includes desserts and other baked goods.

2017; Whitehead 2018). With American households spending more on food away from home over the past three decades (Saksena et al. 2018), these findings reinforce the importance of menu labeling standards as one promising mechanism to encourage industry reformulation for both food establishments.

A growing number of consumers are spending more of their food budget on food purchased at convenience stores and less on food from large restaurant chains (Maze 2017). Efforts aimed at combating diet-related disease should consider the shifting role of convenience stores, which are not only a source of unhealthy snack foods and beverages, but offer an increasing number of prepared foods at low prices (Larson et al. 2009; Morland et al. 2006; Rose et al. 2009). Furthermore, food items sold at convenience stores may be disproportionately consumed by populations at high risk of obesity and related chronic disease. An estimated 4.1 million adolescents in the U.S. visit convenience stores at least once a week (Sanders-Jackson et al. 2015), with African American adolescents more likely to visit convenience stores on a weekly basis compared to their peers who belong to other racial/ethnic groups (Sanders-Jackson et al. 2015). Lastly, consumers often attribute unhealthy options and food quality as their top concerns at convenience stores (GasBuddy 2019). Therefore, in addition to the increasing demand for prepared food items that are quicker and more convenient, convenience store chains may also be working towards reformulating their food offerings to address consumer concerns over nutrition and food quality.

Pizza is also a significant source of both total and excess calories among adolescents and children (Poti et al., 2014). In a cross-sectional study of > 3000 U.S. children aged 2 to 18 years, pizza purchased at fast-food restaurants contributed more solid fat (e.g., saturated and trans-fatty acids) to the diet than sandwiches, hamburgers, and many other food categories (Poti et al., 2014). Among children and adolescents, respectively, pizza has been found to comprise 5% and 7% of total energy intake (Powell et al. 2015), suggesting that even small changes to menus may potentially reduce energy intake at the population level. In addition, pizza comprises an estimated 4% of the total energy for all adults in the U.S. (Rhodes et al. 2014).

Future research should continue to track voluntary reformulation within large chain restaurants. It will be especially important to compare changes to restaurant menus pre- and post-implementation of the final federal menu labeling rule. Should the observed trend towards lower calorie items in convenience chains be amplified in response to implementation, the potential for improving population health is greater than these results suggest.

#### 4.1. Limitations

The MenuStat database is limited to the nation's largest convenience store and pizza restaurant chains and may not be generalizable to smaller chains. However, the food establishments in our study include four of the country's top 20 convenience store chains by number of stores (Top 202 Convenience Stores, 2018), and eight of the leading 10 pizza chains by annual gross sales (2017 Top 100 Pizza Companies 2017). Second, median calories per item are limited to portion sizes provided on restaurant websites and may not reflect actual consumption. For example, most calorie information for pizza is listed per slice, though the average adult consumes 2–3 slices per serving (McGuire 2014). Therefore, listing caloric content for portions smaller than what is generally consumed may be confusing to consumers. Research findings suggest that consumers often feel less guilt and consume more when food is presented in smaller serving sizes, relative to larger sizes (Mohr et al. 2012). In addition, restaurants often serve food in large portion sizes that exceed those generally recommended (Cohen et al. 2016; Nestle 2003). The larger-sized portions may be confusing to individuals and encourage them to consume more food than necessary (Hollands et al. 2015). Third, our analyses do not account for customized pizzas in which additional toppings and other ingredients are

added to pre-established menu items. Fourth, given caloric information were obtained from establishment websites, the translation of such data to MenuStat is subject to human error. Results from prior research, however, suggest nutrition data provided from restaurants are generally accurate (Reports 2013). Lastly, our analyses do not reflect individual sales of items but highlight those available for purchase.

## 5. Conclusion

Convenience stores and pizza restaurant chains represent a growing share of prepared food purchases in the U.S. These results suggest that, like other large chain restaurants, convenience stores have reduced calories from 2013 to 2017 and added lower calorie items to the menu. These changes may have been due to the anticipation of the May 2018 federal menu labeling rule or in response to shifts in consumer demand for lower calorie options. Regardless, the observed changes in convenience stores have the potential to improve population health. By contrast, we observed few changes in the calories of menu items at pizza restaurants. Further research is needed to explore both the pre/post and long-term impact of the federal menu labeling mandate on the calories of food items offered at both convenience stores and pizza restaurant chains, and on calories purchased and consumed in these venues.

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## Human subjects

No protocol approval was needed as this study did not include human subjects.

## Declaration of Competing Interest

Conflicts of interest: none.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2019.100932>.

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