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Availability and nutrient composition of vegetarian items at U.S. fast food restaurants

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1 **Research Question:** What are patterns in availability of vegetarian items in U.S. fast food chains
2 (2012 to 2018) and are there differences in nutrient composition between and within vegetarian
3 and non-vegetarian items annually and over time?

4 **Key Findings:** In this longitudinal analysis of secondary data, the annual proportion of
5 vegetarian items remained consistent (~20%, annually). Overall, vegetarian items had
6 significantly fewer calories, saturated fat, unsaturated fat, protein, and sodium annually than non-
7 vegetarian items but increases in per-item sodium (+2.0mg per year before calorie adjustment)
8 and unsaturated fat (+0.2g per year before calorie adjustment) among vegetarian items suggest
9 surveillance remains important as vegetarian options increase in popularity.

10 Abstract (300/300 words)

11 **Background:** Consumer demand for vegetarian options is growing. Fast food restaurants have
12 responded by adding high-profile vegetarian offerings but little is known about the overall
13 availability or nutrient profile of vegetarian options at these establishments, or how these items
14 compare to non-vegetarian items.

15 **Objective:** The purpose of this study was to quantify trends in the availability and nutrient
16 profile of vegetarian items in U.S. fast food restaurants from 2012-2018.

17 **Design:** This study was a longitudinal analysis of secondary data. We used nutrient data from the
18 MenuStat database for menu offerings at 36 large U.S. fast food chain restaurants (2012 to
19 2018). Vegetarian items were identified through automated key-word searches and item
20 description hand-coding.

21 **Outcome Measures:** Annual counts and proportions of vegetarian and non-vegetarian items by
22 category, and annual trends and differences in predicted mean calories; saturated, unsaturated,
23 and *trans* fat; sugar; non-sugar carbohydrates; protein; sodium between and within vegetarian
24 and non-vegetarian items.

25 **Statistical analysis performed:** We report counts and proportions of vegetarian items by menu
26 category, then use tobit regression models to examine annual trends and differences in predicted
27 mean nutrients between and within vegetarian and non-vegetarian items. Sensitivity analyses
28 were calorie-adjusted.

29 **Results:** The annual proportion of vegetarian items remained consistent (~20%), while counts
30 increased (2012, n=601; 2018, n=713). Vegetarian items had significantly fewer calories (2018: -
31 95 kcals) and, even after adjustment for calories, lower saturated fat (-1.6g), unsaturated fat (-
32 1.8g), protein (-3.8g), and sodium (-62mg) annually (p's <0.05) compared to non-vegetarian

33 items. Vegetarian items were significantly higher in sugar (2018: +2.0g, $p < 0.01$) and non-sugar
34 carbohydrates (2018: +9.7g, $p < 0.01$), after calorie adjustment, compared to non-vegetarian
35 items.

36 **Conclusions:** Vegetarian items were generally lower in several overconsumed nutrients of public
37 health concern (e.g., sodium, saturated fat) than non-vegetarian items, but nutrient changes
38 suggest surveillance remains important as vegetarian options increase in popularity.

39 **Introduction**

40 Fewer than 5% of Americans identify as vegetarian (avoiding the consumption of meat products)
41 ^{1,2} but nearly one-in-four report actively reducing meat intake, citing health and environmental
42 concerns ^{3,4}. Though fast food restaurants remain a primary source of processed meats ⁵, the U.S.
43 restaurant industry has documented increasing consumer demand for vegan, vegetarian, and
44 plant-based items ⁶. Several large fast food chains have subsequently introduced high-profile
45 biomimicry meat products ⁷ and restaurant industry reports have identified increasing prevalence
46 of plant based, vegetarian, and vegan items as among the top restaurant menu trends in 2020 ⁸.

47 However, little is known about overall availability or nutrient profile of existing
48 vegetarian items at fast food restaurants or how these compare to non-vegetarian items.
49 Understanding these trends is of public health concern because over half of food spending is on
50 food away from home (two-thirds of that is at restaurants) ⁹, 37% of American adults eat fast
51 food daily ¹⁰, fast food consumption is associated with increased risk for obesity and diet-related
52 diseases ¹¹⁻¹³, and – regardless of nutrition content – consumers perceive vegetarian items as
53 healthier than non-vegetarian items ¹⁴.

54 In this study, we documented patterns in availability of vegetarian items in 36 of the
55 highest-grossing U.S. fast food chains (2012 to 2018) and examined differences in nutrient
56 composition between and within vegetarian and non-vegetarian items annually and over time.

57 **Methods**

58 We obtained data from the MenuStat project, described elsewhere ¹⁵, and limited our sample to
59 fast food restaurants (n=36), excluding beverages, desserts, baked goods, and
60 toppings/ingredients (**Table 1 Supplementary**). For items available in multiple sizes (e.g., small,

61 medium, large French fry), we included the largest size to ensure comparability. The final
62 analytic sample contained 6,141 unique items and 21,556 items across menu-years (2012 to
63 2018) (**Table 2 Supplementary**). We defined vegetarian items as those that would align with a
64 vegetarian diet, and therefore did not include meat products (e.g., beef, pork, poultry, fish,
65 shellfish) but may or may not include egg and dairy products.¹⁶ To categorize items, we
66 conducted automated searches of item names and descriptions using meat-associated keywords
67 (**Table 3 Supplementary**), then hand-coded remaining non-categorized item names and
68 descriptions to classify those not captured during the automated process.

69 Outcomes of interest were: 1) the annual count and proportion of vegetarian and non-
70 vegetarian items; 2) annual predicted mean, per-item nutrients (calories; saturated, unsaturated,
71 and *trans* fat; sugar; non-sugar carbohydrates; protein; sodium) for vegetarian and non-
72 vegetarian items; 3) annual nutrient differences between vegetarian and non-vegetarian items;
73 and 4) linear trends in nutrients within vegetarian and non-vegetarian items (2012 to 2018). We
74 excluded items with no caloric content in any year (n=733). Items missing values in every year
75 for saturated fat (n=788), *trans* fat (n=964), sugar (n=801), non-sugar carbohydrates (n=768),
76 protein (n=777), and sodium (n=767) were exclusively dropped from that respective nutrient
77 analysis. Items whose values were missing in a single year for calories (n=313), saturated fat
78 (n=306), *trans* fat (n=473), sugar (n=343), non-sugar carbohydrates (n=319), protein (n=312),
79 and sodium (n=320) were imputed using the value from the closest available year.

80 All analyses contained full interactions between the three main independent variables
81 (year, menu category, and vegetarian [yes/no]) to allow vegetarian and non-vegetarian items to
82 vary by category and year. Consistent with previous studies¹⁷⁻²², we adjusted for item-level

83 covariates (**Table 4 Supplementary**). We conducted additional sensitivity analyses among
84 nutrient outcomes by adjusting for caloric content.

85 The unit of analysis was a menu item in each year. We used tobit regression models to
86 account for truncation of nutrient content at zero that might otherwise bias predicted means and
87 overinflate standard errors²³. The margins command was used to estimate outcomes of interest.
88 We used the cluster command in Stata, Version 15, to adjust standard errors and account for item
89 non-independence across years. Analyses were conducted in 2019. Review by the institutional
90 review board (IRB) was not required for this study because human subjects were not involved.²⁴

91 **Results**

92 **Figure 1** shows counts and proportions of vegetarian items in the 36 fast food chain restaurants
93 (2012 to 2018), overall and by menu category (details in **Table 2 Supplementary**). Vegetarian
94 items consistently accounted for one-fifth of menus annually. The proportion of vegetarian items
95 within menu categories was relatively stable, with the exception of entrees, where the proportion
96 of vegetarian items decreased from 23% (2012, n=414 of 2,793) to 15% (2018, n=638 of 3,315).
97 The appetizers/sides category contained the largest proportion of vegetarian items overall
98 (60.9%) and annually (range, 2013: 57.0% to 2018: 64.2%); the burger category was the smallest
99 overall (1.0%) and annually (range, 2014: 0.04% to 2018: 1.8%). The number of available
100 vegetarian items decreased from 2012 (n=601) to 2013 (n=597), then increased annually through
101 2018 (n=713).

102 **Figure 2** shows annual predicted mean per-item calories, saturated fat, sugar, and sodium
103 values for vegetarian and non-vegetarian items, overall (estimated values, **Table 5**
104 **Supplementary**). Annually, vegetarian items were significantly lower than non-vegetarian items

105 with respect to calories (2018: -95kcal, $p < 0.001$), saturated fat (2018: -2.7g, $p < 0.001$),
106 unsaturated fat (2018: -4.9g, $p < 0.001$), protein (2018: -7.5g, $p < 0.001$), and sodium (2018: -
107 251mg, $p < 0.001$), and consistently lower in *trans* fat and higher in sugar, though significance
108 varied. Among all vegetarian menu items, annual trends for sodium (+2.0mg, [95% CI: 0, 4]) and
109 unsaturated fat (+0.2g, [95% CI: 0.0, 0.4]) significantly increased while protein decreased (-0.1g,
110 [95% CI: 0.0, -0.3]). Vegetarian options in all menu categories were lower in calories and
111 sodium than non-vegetarian items annually; significance varied (**Table 5 Supplementary**).

112 When we calorie-adjusted the analyses for vegetarian and non-vegetarian items (**Table 6**
113 **Supplementary**), vegetarian items were significantly higher in sugar (2018: +2.0g, $p < 0.01$) and
114 non-sugar carbohydrates (2018: +9.7g, $p < 0.01$), annually, compared to non-vegetarian items.
115 Annual differences for saturated fat, *trans* fat, unsaturated fat, protein, and sodium remained
116 largely unchanged. Among all vegetarian menu items, annual trends for sodium and unsaturated
117 fat were no longer significant after calorie-adjustment.

118 **Discussion**

119 From 2012 to 2018, the proportion of vegetarian items in U.S. fast food restaurants remained
120 relatively stable. Vegetarian options were lower in several overconsumed nutrients of public
121 health concern (e.g., saturated fat, sodium) than non-vegetarian items, though differences were
122 inconsistent across menu categories and the nutritional profile of both vegetarian and non-
123 vegetarian items leaves substantial room for improvement.

124 For fast food restaurants, where portions are typically larger²⁵ and higher in calories and
125 fat than foods consumed at home²⁶, efforts to increase vegetarian offerings could meet consumer
126 demands^{3,6} and may reduce consumption of overconsumed nutrients of public health concern.

127 Previous research in this area indicates that increasing the proportion of vegetarian options may
128 impact consumer behavior more than changes in the absolute number of items ²⁷. Therefore,
129 realizing the impact of healthier vegetarian options may require substantial shifts in the
130 proportion of vegetarian items, which our data indicate have not happened to-date, as well as
131 improvements in their nutritional profiles. Previous work in France, for example, on willingness-
132 to-pay for soy burgers suggests that marketing messages relating to the health and environmental
133 benefits of this product relative to beef burgers have relatively weak effects.²⁸ Thus, future
134 research in the US should involve strong partnerships across the public health, marketing, and
135 food industry sectors to facilitate the development and testing of effective messages to reduce
136 meat consumption and increase plant-based food intake. Some important steps will be
137 identifying consumer motivations for vegetarian foods as well as testing and deploying effective
138 strategies with the greatest potential to shift dietary intake without decreasing restaurant sales.²⁹⁻
139 ³¹

140 Among vegetarian items, we note that nutrient composition changes justify monitoring.
141 For example, we observed a statistically significant sodium increase of 11mg (about 2mg per
142 annum, 2012 to 2018) before calorie adjusting. While this finding was not clinically significant,
143 several recently-introduced high-profile vegetarian options, not included in our data ⁷, are as high
144 or higher in overconsumed nutrients than their direct, non-vegetarian equivalent (e.g., Impossible
145 Whopper, 1080mg sodium; Original Whopper, 980mg sodium) ³². These changes are of particular
146 concern, as vegetarian and vegan items may be viewed as healthier (e.g., having fewer calories)
147 than non-vegetarian items, regardless of nutritional content. ¹⁴ Moreover, sales for vegetarian and
148 vegan items have generally surpassed market expectations in the short-term, ³³ though their long-
149 term popularity as a staple menu item is relatively unknown³⁴. While it is true that vegetarian

150 diets can offer substantial health benefits ¹⁶ and have been identified as an effective treatment for
151 overweight ^{35,36}, are associated with a reduced risk of cardiovascular disease ³⁷, improved blood
152 pressure ^{38,39}, improved insulin sensitivity ^{39,40}, and improved blood lipid profiles ⁴¹, the relative
153 healthfulness of individual vegetarian products are far from uniform⁴². Increasing evidence from
154 prospective cohorts show that not all vegetarian diets are created equal, and those high in fruit
155 juices, refined grains, potatoes, sugar sweetened beverages, and sweets and desserts, actually
156 increase risk of coronary heart disease.⁴³

157 Calorie adjusted analyses of annual differences between vegetarian and non-vegetarian
158 items were largely unchanged, with the exception of a few key nutrients. Sugar and non-sugar
159 carbohydrates were higher among vegetarian items, indicating that these nutrients are higher
160 among vegetarian items, independent of calories. Increases in sodium and unsaturated fat among
161 vegetarian items over the study period were no longer significant after calorie adjustment,
162 indicating that changes in these nutrients may be tied to item size and caloric density. To better
163 understand the impact of the absolute or relative (i.e., calorie-adjusted) nutritional content of fast
164 food items, it will be important to continue to survey fast food restaurant menus. In addition,
165 more research is needed to better understand purchase and consumption patterns at fast food
166 restaurants, as consumer behavior will likely influence the public health impact of any menu
167 changes.

168 To our knowledge, this is one of the first studies examining differences in the nutrient
169 profile of vegetarian and non-vegetarian options at large fast food chain restaurants in the U.S.
170 Marketing and popular press articles suggest increasing interest in vegetarian options in
171 restaurants ^{6,7}, warranting continued surveillance. As the number of vegetarian options increases
172 in fast food settings, future research should document shifts in the proportion of vegetarian items,

173 which may have more profound impact on consumption than increases in counts alone²⁷.
174 Additionally, research should examine changes in the nutrient profile of vegetarian options and
175 assess the potential for policy solutions, like sodium labeling, to influence consumer purchases
176 and improve public health.

177 We note several limitations. First, data are limited to 36 U.S. fast food chains and cannot
178 be generalized to other restaurant types. Second, data were collected from online menus and are
179 subject to misreporting or human error in data entry, though prior research found these data to be
180 generally accurate and data collection methods are rigorous¹⁵. Third, data from MenuStat are
181 collected annually in January, and do not include seasonal items or items released in subsequent
182 months; our data do not contain items released after January 2018, including several high-profile
183 meat alternatives⁷. Next, MenuStat data are limited by the nutrients reported by restaurants,
184 which do not consistently include micronutrients of particular interest in vegetarian diets such as
185 B-12, zinc, iodine, vitamin D, iron, and calcium,¹⁶ and data for potassium and fiber, both largely
186 underconsumed in the US diet, are not consistently available (e.g., 95% of data for potassium
187 were missing). Finally, we lack sales, price, and consumption data and cannot account for item
188 popularity or subsequent impact of differences in nutrients consumed.

189 **Conclusions**

190 The proportion of vegetarian items on U.S. fast food menus remained constant from 2012
191 to 2018. While vegetarian items were generally lower in nutrients of public health concern than
192 non-vegetarian items, shifts in nutrient profile among vegetarian items, particularly sodium,
193 warrants monitoring. Continued surveillance and transparency about the healthfulness of
194 vegetarian items remains important as demand increases.

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Figure legends

Figure 1. Annual count and classification (vegetarian or non-vegetarian) of items on 36 fast food restaurant menus, overall and by menu category, 2012-2018

Notes. N includes all items available on menus in each year excluding beverages, toppings and ingredients, baked goods and desserts. Appetizers and sides includes fried potatoes and soups

Figure 2. Predicted mean per-item calories, saturated fat, sugar, and sodium for food items (vegetarian or non-vegetarian) on 36 fast food restaurant menus, 2012-2018

Note: We excluded items with no caloric content in any year (n=733). Items missing values in every year for saturated fat (n=788), trans fat (n=964), sugar (n=801), non-sugar carbohydrates (n=768), protein (n=777), and sodium (n=767) were dropped from that respective nutrient analysis. Items whose values were missing in a single year for calories (n=313), saturated fat (n=306), trans fat (n=473), sugar (n=343), non-sugar carbohydrates (n=319), protein (n=312), and sodium (n=320) were imputed using the value from the closest available year.

* Statistically significant difference between vegetarian and non-vegetarian items in individual year at $p < 0.05$.

† P-value for linear trend among vegetarian items is significant at $p < 0.05$