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A bit or a lot on the side? An observational study of the energy content of starters, sides and desserts in major UK restaurant chains

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Manuscripts

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2
3 22 **Abstract**

4
5 23 Objectives: Main meals served by UK restaurants often have an excessive energy content, but
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7 24 the energy content of other menu sections has not been examined. Our objective was to
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9 25 examine the kilocalorie (kcal) content of starter, side and dessert dishes served in major UK
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11 26 restaurant chains, comparing the kcal content of these dishes in fast-food and full-service
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13
14 27 restaurants.

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16 28 Design: Observational study.

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18 29 Setting: Menu and nutritional information provided online by major UK restaurant chains.

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20 30 Method: During October to November 2018, we accessed websites of restaurant chains with
21
22 31 50 or more outlets in the UK. Menu items that constituted starter, side or dessert dishes were
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24 32 identified and the kcal content of these dishes was extracted. Any accompanying beverage
25
26 33 kcals were not included.

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28 34 Main outcome measures: The mean kcal content of dishes and the proportion of dishes
29
30 35 exceeding public health recommendations for energy content in a main meal (>600kcal).

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32 36 Results: A total of 1009 dishes (212 starters, 317 sides and 480 desserts) from 27 restaurant
33
34 37 chains (21 full-service, 6 fast-food) were included. The mean kcal content of eligible dishes
35
36 38 was 477.0 (SE=25.9) for starters, 321.5 (SE=20.3) for sides and 488.4 (SE=35.05) for
37
38 39 desserts. The percentage of dishes which exceeded 600kcal was 26.4% for starters, 21.8%
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40 40 for sides and 20.4% for desserts. Compared to fast-food chains, desserts offered at full
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42 41 service restaurants were on average more calorific and were significantly more likely to
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44 42 exceed 600kcal.

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46 43 Conclusions: The average energy content of sides, starters and desserts sold in major UK
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48 44 restaurants is high. One in four starters and one in five sides and desserts in UK chain
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50 45 restaurants exceed the recommended energy intake for an entire meal.

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3 47 **Strengths and limitations of this study**
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- 5 48 • This is the first study of which we are aware to assess the energy content of starter,
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7 side and dessert dishes in the UK eating out sector.
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10 50 • Our findings will be of use to future evaluations of how the out of home food sector
11
12 respond to voluntary or mandatory public health actions through food product
13 51
14 reformulation.
15 52
16
17 53 • Smaller chains and independent restaurants were not included, however there is
18
19 evidence that both chain and non-chain restaurants tend to serve highly calorific foods
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21
22 55 • We could only use the nutrition data that restaurants made available, which excluded
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24 several dishes from our analyses.
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Introduction

Overweight and obesity are now common in most of the developed world. For example, in the UK two in three adults and one in three children are now classed as being overweight or obese¹. Although obesity is a multifactorial disease, it is clear that changes to the food environment has been a key factor driving the global obesity epidemic^{2,3}. Eating out of the home is becoming increasingly common, with 39% of adults reporting eating out at least once a week in a recent UK study⁴. Eating out of the home is associated with higher energy consumption and research suggests that frequently eating out of the home is a risk factor for obesity⁵. The consumption of 'fast-food' meals has been widely identified as a cause for concern, due to the low nutritional quality and high energy content of meals served in these restaurants⁶. Because of this, the out of home food sector has now been identified as an area for public health policy intervention in the US⁷ and UK government are currently considering similar policy action⁸. However, most of the research on the nutritional quality of food eaten out of the home has been conducted in North America, a region with a particularly high prevalence of obesity^{6,9,10}. There has been little research examining the nutritional quality of food sold out of the home in the UK, although a small study of meals sold in independent small scale takeaway outlets has shown that energy content can be excessive¹¹. In a recent study we examined the kilocalorie content of main meals sold by major restaurant chains in the UK¹². We found that the average kilocalorie content of main meals was high and very few meals adhered to public health recommendations for main meal kilocalorie consumption (≤ 600 kcal) recently suggested by Public Health England¹³. Moreover, we found that main meals sold by full-service restaurants tended to be more calorific than those sold by fast-food restaurants, which is consistent with data from North American restaurants¹⁴. However, previous research has focused on main meal dishes and as consumers regularly order starters, sides and/or desserts as part of their meal out of the home,

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3 82 the aims of the present study were to assess the average energy content of starter, side and
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5 83 dessert dishes sold in major UK restaurant chains. Based on ¹² Robinson et al. (2018), we also
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7 84 examined how common it was for starter, side and desserts dishes to exceed the amount of
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9 85 calories recommended for an entire meal whether these dishes would be more calorific at
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11 86 full-service, as opposed to fast-food restaurants.
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15 87 **Methods**

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17 88 We pre-registered the study protocol and analysis plan on the Open Science Framework
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19 89 (<https://osf.io/6cfdb/>)
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22 90 *Restaurant sampling.* Previously ¹² we identified restaurant chains with ≥ 50 outlets in the
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24 91 UK by consulting market reports listing restaurants with the largest number of UK outlets,
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26 92 and market research ranking UK restaurant chains by annual turnover, popularity, number of
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28 93 users, and numbers of outlets ¹⁵⁻¹⁸. If the number of UK outlets was not provided on a
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30 94 restaurant website, this information was requested by email.
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33 95 *Characterising restaurant types.* As in ¹² we classified restaurant chains as ‘fast-food’ or
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35 96 ‘full-service’ restaurants using the following definition of fast-food restaurants: ‘*Restaurants*
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37 97 *that primarily provide consumers with largely pre-prepared ‘quick’ meals with little or no*
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39 98 *table service, with in-store seating and in which take-away orders are likely to account for a*
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41 99 *significant proportion of orders*’. Therefore, coffee shops and take-away only outlets were
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43 100 not considered eligible. Previously two researchers independently categorised each of the
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45 101 included restaurant as fast-food or full-service with any disagreements resolved by a third
46
47 102 researcher ¹².
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51 103 *Data sources.* To access current menus and nutritional information, two researchers visited
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53 104 the restaurants’ UK web pages during October and November 2018 and accessed online
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55 105 versions of current menus. If a restaurant only had a downloadable menu (PDF), and no
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57 106 website menu, we used the former. If there were several menus (e.g. specials menus), only
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3 107 the 'main menu' was used for coding. If there was no menu clearly labelled as the 'main'
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5 108 menu then we used the restaurant's 'evening menu'.
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8 109 *Starters, sides, desserts menu options.* We examined the kcal content of starters, sides and
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10 110 dessert menu options. We defined a starter/side/dessert item as being a menu option that is
11
12 111 not a main meal dish, is an individually sold food item and can be ordered on its own, as
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14 112 opposed to a more specific addition to a menu item (e.g. steak sauce, ice cream toppings). We
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16 113 excluded menu items that could not be ordered by all consumers (e.g. items from senior
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18 114 citizens menu section, children's menu section) and excluded platters and sharers (unless the
19
20 115 menu indicated the number of people per serving) as we could not confidently identify what
21
22 116 combination of sharing menu options would constitute a starter, side or dessert for one
23
24 117 person. Small plates (tapas) were not eligible unless they were part of a section of the menu
25
26 118 that was labelled as starters, side dishes or desserts. We also excluded menu items with
27
28 119 unspecified portion size, such as "unlimited" or "bottomless" options as we would not be able
29
30 120 to calculate energy content. In instances in which a menu option could be customized at the
31
32 121 request of the patron for an additional charge (for example add extra toppings), we only
33
34 122 extracted the default composition of the menu option. In instances in which a menu option
35
36 123 required a customer to make an explicit choice (e.g. choice of topping for a starter or dessert
37
38 124 accompaniment), we identified all possible configurations for the item and record each as an
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40 125 individual menu item (e.g. chocolate cake with ice cream, chocolate cake with custard) If a
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42 126 menu item appeared on the menu as served with a drink of choice, we excluded it as a
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44 127 scoping exercise indicated that this was uncommon and our focus is on energy content of
45
46 128 food items. Finally, to minimize effects of season, we only included options that were
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48 129 available all year round and/or not sold everyday (e.g. only on specific days, such as 'soup of
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50 130 the day').
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3 131 Two researchers (F.S and C.A.R) independently identified menu options from each restaurant
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5 132 and a third researcher (M.M) checked their eligibility according to the protocol and resolved
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8 133 any discrepancies. As there was a very high number of menu sections that were not eligible
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10 134 (e.g. main meals, sharers, drinks, children's menu, Sunday menu) coders did not record a
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12 135 classification (eligible vs. not eligible) for every item on each menu. As in (12) we used an
13
14 136 approximated inter-coder consistency by calculating the number of menu items deemed
15
16 137 eligible by both coders vs. the number of menu items included by only one of the coders.
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19 138 *Extraction of dish kcal content.* As above F.S and C.A.R accessed the online nutritional
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21 139 information for each restaurant (October 2018) and extracted the number of kcals per menu
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23 140 item. M.M cross-checked kcal extraction for accuracy.
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26 141 **Statistical analysis**

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28 142 *Primary analyses – average number of kcals:* Menu items were nested within individual
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30 143 restaurants so we planned to use multi-level analyses. We first examined if a multi-level
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32 144 analysis was appropriate for starters, sides and dessert kcals separately by examining the
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34 145 portioning of variance attributed to differences in kcals between restaurants (between
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36 146 restaurant variance/(between restaurant variance + within restaurant variance)). We examined
37
38 147 the multilevel model fit by comparing the loglikelihood ratio statistic (loglikelihood of the
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40 148 multilevel model - loglikelihood of the single-level model) to a chi-squared distribution with
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42 149 1 degree of freedom. We used bootstrapping (500 samples) to improve the accuracy of
43
44 150 parameter values and reduce bias in parameter estimates. Statistical significance ($p < .05$)
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46 151 indicated meaningful variation in kcals of menu items between restaurants and a multilevel
47
48 152 model was used. In all statistical tests α was set at .05 and we report 95% confidence intervals
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50 153 for significance testing. Where multilevel modelling was not appropriate we used
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52 154 conventional frequentist statistics, maintaining $p < .05$ as the level of statistical significance.
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3 155 *Secondary analyses.* Public Health England recommends that adults do not exceed 600kcal
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5 156 for a complete meal at lunch and dinner (8). There are no specific recommendations for
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7 157 individual components (e.g. energy from sides) of a meal, so we examined how common it
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9 158 was for starters, sides and desserts to be excessive in kcal content by calculating the
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11 159 proportion of menu items that exceed an entire meal's worth of kcal (600kcal). We
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13 160 examined differences between the two restaurant types (fast-food vs. full-service) by using
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15 161 one-level binary logistic regressions. Because variability in menu item kcal content between
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17 162 restaurant types may be in part explained by the two types of restaurant serving different
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19 163 types of dishes, we examined whether there were dishes that were routinely sold by both
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21 164 types of restaurant (e.g. side of fries/chips, salad) and we compared the average number of
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23 165 kcal for these dish types by restaurant type.
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31 167 **Results**

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33 168 *Restaurants.* Fifty-two eligible restaurant chains were identified and of these 30 restaurants
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35 169 had available menus and nutritional information. We requested this from the remaining
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37 170 chains but only one provided this information. Because we examined main meal
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39 171 accompaniments (starters, sides, desserts) we excluded four restaurants that only tended to
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41 172 sell individual food items that customers choose from to form a meal (e.g. pieces of chicken,
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43 173 pieces of sushi) leaving 27 restaurants in the final sample (n=6 fast-food, n=21 full-service
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45 174 restaurants). See Table 1 for restaurants included.
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49 175 *Menu items.* Of all the menu items identified by either of two coders (1494), the first coder
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51 176 identified 74 items which were not identified by the second coder (95.1% agreement) and the
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53 177 second coder identified 35 items not identified by the first coder (97.7% agreement),
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55 178 indicating reasonable consistency between the two coders in identifying eligible dishes. The
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57 179 items in disagreement were then reviewed by a third researcher and after these discrepancies
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3 180 were resolved, the final number of eligible dishes was 1361. We were able to extract kcal
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5 181 information for 1009 dishes (74.1% of eligible items) and the remaining dishes were treated
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8 182 as missing data and not included in analyses. See Table 1 for number of eligible dishes per
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10 183 restaurant.

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12 184 *Mean kcal content of menu items (Table 1).* For all three groups (starters, sides and desserts)
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14 185 two-level model (dishes within restaurants) was a better fit of the data than a single level
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17 186 model. The variance partition coefficient; the total residual variance which is attributable to
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19 187 restaurants rather than individual dishes was 14.7% (model fit: $\chi^2(1) = 18.14, p < .001$) for
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21 188 starters, 51.8% (model fit: $\chi^2(1) = 123.41, p < .001$) for sides, and 45.1% (model fit: $\chi^2(1) =$
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23 189 198.08, $p < .001$) for desserts, indicating that multi-level modelling was appropriate. In a
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25
26 190 two-level model (individual dishes nested within restaurants), the average number of kcals
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28 191 for starters was 477.0 (SE=25.9), for sides was 321.5 (SE=20.3) and for desserts was 488.4
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30 192 (SE=35.05).

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33 193 Next, we compared the average number of kcal in sides and in desserts between fast-food and
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35 194 full-service restaurants, as there were no starters identified in the fast-food restaurants. Type
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38 195 of restaurant (fast-food vs. full-service) was not a significant predictor of kcal content for
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40 196 sides, $\beta = 3.19, SE = 11.84$ (95% CIs -20.02 to 26.40), $p = .79$) indicating that sides offered at
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42 197 fast-food restaurants had on average only 3.19 kcals more energy than sides from fast-food
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44 198 restaurants. Desserts had on average 249.47 more kcal in full-service than in fast-food chains
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47 199 ($\beta = 249.47, SE = 69.74$ (95% CIs 112.78 to 386.16), $p = .001$) and this difference was
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49 200 statistically significant.

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51 201 *Mean kcal content of specific dish types (Table 2).* The most common side dish available was
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53 202 chips/fries. To compare the average kcal content of chips between the fast-food and full-
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56 203 service restaurants we selected only chips/fries menu options that were plain, with no sauces
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58 204 or spices, toppings or extras and were served as sides. That resulted in inclusion of 40 menu
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3 205 items, offered in 20 restaurants (out of the 27), including five out of six fast-food chains
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5 206 (n=13 items), and 15 out of 21 full-service chains (n=27 items). The small number of items
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7 207 eligible for this sub-analysis did not lend itself to multilevel analysis so we used a t-test to
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9 208 compare the types of restaurants. The average number of kcals was 461.6 (SE=37.8) across
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11 209 all restaurants. Chips/fries in full-service restaurants had on average 226.2kcal more energy
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13 210 than in fast-food restaurants (535.1kcal vs 308.9kcal) and the type of restaurant (full-service
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15 211 vs. fast-food) was a significant predictor ($p < .01$). Ice-cream dishes were the most frequently
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17 212 served dessert across restaurants. We selected only ice-creams made of dairy cream, therefore
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19 213 items such as sorbets, vegan ice creams, and other desserts that included ice-cream (such as
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21 214 cake with ice cream) were excluded from the comparison. Ice-creams were served in 19 out
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23 215 of 27 restaurants (4 of 6 fast-foods and 15 of 21 full-service), with a total of 128 items (24 in
24
25 216 fast foods and 104 in full-service). The average amount of kcals in ice-cream dishes was
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27 217 383.4 (SE=23.7). Full-service restaurant ice-cream dishes had on average 178.3 kcals more
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29 218 than fast-food ice-cream dishes (416.8kcal vs. 238.5kcal) and this difference was statistically
30
31 219 significant ($p < .01$).

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33 220 *Menu items >600kcal.* Of the 212 starters identified, 56 (26.4%) exceeded 600kcal per dish
34
35 221 and all starter dishes were from full-service restaurants. Of the 317 side dishes, 69 (21.8%)
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37 222 had >600kcal. Logistic regression models examining proportion of dishes >600kcal
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39 223 demonstrated significant variance at the restaurant level (Wald Test Statistic = 8.81, $p =$
40
41 224 .003). The proportion of sides >600kcal was not significantly larger in sit down restaurants
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43 225 compared to fast food restaurants (OR = 0.98 (95% CIs: 0.14 to 6.55, $p = .982$). Among the
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45 226 480 identified desserts, 98 (20.4%) exceeded 600kcal. Logistic regression models
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47 227 examining proportion of dishes >600kcal demonstrated significant variance at the restaurant
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49 228 level (Wald Test Statistic = 7.68, $p = .006$). The proportion of desserts exceeding the 600kcal
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3 229 was 13.7 times larger in sit-down compared to fast food restaurants (OR = 13.69: 95% CIs
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5 230 2.27 to 83.10, $p = .001$).
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Discussion

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13 233 The present study examined the energy content of starter, side and dessert dishes sold by
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15 234 major UK restaurant chains. We found that the average number of kilocalories in starter
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17 235 dishes, side dishes and dessert dishes was 477, 322 and 488 kilocalories respectively. We also
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19 236 examined the proportion of these dishes that we deemed to be ‘excessive’ by identifying
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21 237 those with more than 600 kilocalories; the recommended kilocalorie content of a full lunch or
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23 238 dinner meal in the UK ¹⁹. We identified that one in four starters and one in five sides and
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25 239 desserts exceeded the amount of energy recommended for a full meal. Results also indicated
26
27 240 that kilocalorie content of dishes was associated with restaurant type. When comparing types
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29 241 of restaurants, we found that desserts were significantly higher in kilocalories in full-service
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31 242 vs. fast-food restaurants.
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38 244 Our results are in line with studies that have examined the energy content of North American
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40 245 restaurant food and a recent UK study ^{10,12,14,20,21}. Based on these results, the average energy
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42 246 content of a three-course meal (starter, main meal, dessert) in a major chain restaurant in the
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44 247 UK would be approximately 1,787 kilocalories, which equates to close to three times the
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46 248 recommended energy intake for a main meal, and 89% of the recommended daily
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48 249 consumption of kilocalories for women or 71% for men. Although individual energy
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50 250 requirements vary according to levels of physical activity, age, gender, and body mass,
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52 251 frequent eating out of home combined with the relatively high energy content of restaurant
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54 252 dishes (including starters, sides and desserts) may contribute to excessive energy intake that
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56 253 is now common in the UK and other high-income countries. The present research has
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3 254 relevance to public health policy and our results also suggest that policy actions which result
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5 255 in the reduction of the energy content of restaurant food are urgently needed. In September
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7 256 2018, the UK government launched an open consultation on kilocalorie labelling for food and
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9 257 drink served outside of the home. As our study shows, starters, sides and desserts can be
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11 258 highly calorific and, in some cases, exceed the amount of energy recommended for a single
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13 259 meal. We also found a high degree of variability in kilocalorie content in similar dishes
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15 260 across restaurants, which may make it difficult for consumers to estimate energy content
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17 261 without access to nutritional information. For example, the most calorific portion of
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19 262 chips/fries offered in studied restaurant chains had nearly 12 times more than the least
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21 263 calorific (107kcal and 1256kcal) and it was common for ice-cream desserts to vary
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23 264 dramatically in kilocalorie content. Therefore, mandatory kilocalorie labelling in the UK out
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25 265 of home food sector would be appropriate. The present study is the first of which we are
26
27 266 aware of that assesses the energy content of starter, side and dessert dishes in the UK eating
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29 267 out sector, these and the results may be of use to future evaluations of how the out of home
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31 268 food sector respond to voluntary or mandatory public health actions through food product
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33 269 reformulation.
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42 271 *Limitations*

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44 272 The main limitation of our study was that we were unable to include smaller chains or
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46 273 independent restaurants, however the evidence from US suggest that both chain and non-
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48 274 chain restaurants tend to serve highly calorific foods ¹⁰. As there are no guidelines for the
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50 275 limits of calories in different courses of the meal, we examined the proportion of meals
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52 276 exceeding Public Health England's recommendation of 600 kcals or less per entire meal
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54 277 (lunch or dinner). A further limitation of the study was that we were only able to make use of
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56 278 nutrition data from restaurants that made this information available, which excluded several
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3 279 dishes from our analyses. This presents a potential source of bias if the kilocalorie content of
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5 280 restaurants that do not provide nutrition information differs to that of restaurants that do. It is
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7
8 281 also possible that restaurant-provided nutrition information is inaccurate, although research
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10 282 suggests that it is unlikely²².

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14 284 *Conclusions*

16
17 285 The energy content of sides, starters and desserts sold in major UK restaurants is high. One in
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19 286 four starters and one in five sides and desserts in UK chain restaurants exceed the
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21 287 recommended energy intake for an entire meal.

25 288 **Data Sharing**

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28 289 The final data sets containing restaurant dishes' descriptions and number of kcals for each
29
30 290 restaurant used in analyses are available online at <https://osf.io/cd597/>

31
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38
39
40
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42
43 294 those of the authors and not necessarily those of the MRC.

44
45
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47 295

50 296 **Competing interests**

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53
54 297 All authors have completed the ICMJE uniform disclosure form at
55
56 298 www.icmje.org/coi_disclosure.pdf. ER has been a named investigator on research projects

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2
3 299 funded by the American Beverage Association but does not consider this funding a conflict of
4
5 300 interest.
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12 302 **Author statement and Contribution**
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16 303 ER and MM designed the study. MM, CR, FS contributed to data collection. AH provided an
17
18 304 advice and expertise at all stages and helped solving eligibility disagreements. AJ and MM
19
20 305 were responsible for data analysis. MM was responsible for initial drafting of the paper and
21
22 306 all authors approved the manuscript and had full access to the data.
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27 308 **Ethical approval**
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29 309 As the study involved no human or animal participants and made use of publicly available
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31 310 information ethical approval was not required
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36 312 **Transparency**
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39 313 MM acts as the guarantor for this work and confirms that the manuscript is an accurate,
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41 314 transparent and honest account of the study, that no important aspects of the study have been
42
43 315 omitted and that any discrepancies from the study as planned have been explained.
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46 316

47
48 317 **References**
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- 50
51 318 1. Health matters: obesity and the food environment. 2018.
52
53 319 [https://www.gov.uk/government/publications/health-matters-obesity-and-the-food-](https://www.gov.uk/government/publications/health-matters-obesity-and-the-food-environment/health-matters-obesity-and-the-food-environment--2)
54
55 320 [environment/health-matters-obesity-and-the-food-environment--2.](https://www.gov.uk/government/publications/health-matters-obesity-and-the-food-environment/health-matters-obesity-and-the-food-environment--2)
56
57
58
59
60

- 1
2
3 321 2. Livingstone MBE, Pourshahidi LK. Portion Size and Obesity. *Adv Nutr* 2014; **5**(6):
4
5 322 829-34.
- 6
7
8 323 3. MacKay S. Legislative solutions to unhealthy eating and obesity in Australia. *Public*
9
10 324 *Health* 2011; **125**(12): 896-904.
- 11
12 325 4. Adams J, Goffe L, Brown T, et al. Frequency and socio-demographic correlates of
13
14 326 eating meals out and take-away meals at home: cross-sectional analysis of the UK national
15
16 327 diet and nutrition survey, waves 1–4 (2008–12). *Int J Behav Nutr Phys Act* 2015; **12**(1): 51.
- 17
18
19 328 5. Bowman SA, Vinyard BT. Fast Food Consumption of U.S. Adults: Impact on Energy
20
21 329 and Nutrient Intakes and Overweight Status: *J Am Coll Nutr*. 23 (2) (pp 163-168), 2004. Date
22
23 330 of Publication: April 2004.; 2004.
- 24
25
26 331 6. Bauer KW, Hearst MO, Earnest AA, French SA, Oakes JM, Harnack LJ. Energy
27
28 332 content of U.S. fast-food restaurant offerings: 14-year trends. *Am J Prev Med* 2012; **43**(5):
29
30 333 490-7.
- 31
32
33 334 7. Rubin R. Will Posting Nutritional Information on Menus Prod Diners to Make
34
35 335 Healthier Choices? *JAMA* 2018; **319**(19): 1969-71.
- 36
37
38 336 8. Calorie labelling for food and drink served outside of the home. 2018.
39
40 337 <https://www.gov.uk/government/consultations/calorie-labelling-for-food-and-drink-served->
41
42 338 [outside-of-the-home](https://www.gov.uk/government/consultations/calorie-labelling-for-food-and-drink-served-outside-of-the-home).
- 43
44
45 339 9. Urban LE, Lichtenstein AH, Gary CE, et al. The energy content of restaurant foods
46
47 340 without stated calorie information. *JAMA Intern Med* 2013; **173**(14): 1292-9.
- 48
49 341 10. Urban LE, Weber JL, Heyman MB, et al. Energy contents of frequently ordered
50
51 342 restaurant meals and comparison with human energy requirements and US Department of
52
53 343 Agriculture database information: a multisite randomized study. *J Acad Nutr Diet* 2016;
54
55 344 **116**(4): 590-8. e6.
- 56
57
58 345 11. Jaworowska A, M. Blackham T, Long R, et al. *Nutr Food Sci* 2014; **44**(5): 414-30.
59
60

- 1
2
3 346 12. Robinson E, Jones A, Whitelock V, R. Mead B, Haynes A. (Over)eating out at major
4
5 347 UK restaurant
6
7
8 348 chains: observational study of energy content of main meals. *BMJ* 2018.
9
10 349 13. [https://www.gov.uk/government/news/plans-to-cut-excess-calorie-consumption-](https://www.gov.uk/government/news/plans-to-cut-excess-calorie-consumption-unveiled)
11
12 [unveiled.](https://www.gov.uk/government/news/plans-to-cut-excess-calorie-consumption-unveiled)
13
14 350
15 351 14. Scourboutakos MJ, L'Abbe MR. Restaurant menus: calories, caloric density, and
16
17 352 serving size. *Am j prev med* 2012; **43**(3): 249-55.
18
19 353 15. Mintel. Mintel Market Sizes, Restaurants in UK(2017). Report accessed via
20
21 354 University of Liverpool Library, Liverpool, UK. March 2018.
22
23 355 16. Mintel. Mintel Market Sizes, Fast-food and Takeaways in UK (2016). Report
24
25 356 accessed via University of Liverpool Library, Liverpool, UK. Accessed 1st March 2018
26
27 357 17. Statista. Leading restaurant chains ranked by number of users in the United Kingdom
28
29 358 (UK) from 2017. 2017. Report accessed 1st March from
30
31 359 [https://www.statista.com/statistics/586234/restaurant-chains-usage-in-the-uk-by-number-of-](https://www.statista.com/statistics/586234/restaurant-chains-usage-in-the-uk-by-number-of-users/)
32
33 360 [users/](https://www.statista.com/statistics/586234/restaurant-chains-usage-in-the-uk-by-number-of-users/)
34
35 361 18. Statista. Leading restaurant chains ranked by number of users in the United Kingdom
36
37 362 (UK) from 2017. 2017. Report accessed 1st March from
38
39 363 [https://www.statista.com/statistics/586234/restaurant-chains-usage-in-the-uk-by-number-of-](https://www.statista.com/statistics/586234/restaurant-chains-usage-in-the-uk-by-number-of-users/)
40
41 364 [users/](https://www.statista.com/statistics/586234/restaurant-chains-usage-in-the-uk-by-number-of-users/)
42
43 365 19. PHE. Calorie reduction: the scope and ambition for action. 2018.
44
45 366 20. Cawley J, Susskind A, Willage B. The Impact of Information Disclosure on
46
47 367 Consumer Behavior: Evidence from a Randomized Field Experiment of Calorie Labels on
48
49 368 Restaurant Menus. National Bureau of Economic Research, 2018.
50
51 369 21. Auchincloss AH, Leonberg BL, Glanz K, Bellitz S, Ricchezza A, Jervis A. Nutritional
52
53 370 value of meals at full-service restaurant chains. *J Nutr Educ Behav* 2014; **46**(1): 75-81.
54
55 371 22. Urban LE, McCrory MA, Dallal GE, et al. Accuracy of Stated Energy Contents of
56
57 372 Restaurant Foods. *JAMA* 2011; **306**(3): 287-93.
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Table 1. Kilocalorie content of dishes from eligible restaurant chains included in analyses

Restaurant type	Restaurant chain name	N	Starters		Sides		Desserts	
			Number	Mean (SD) kcals	Number	Mean (SD) kcal per dish	Number	Mean (SD) kcals
Fast-food	Burger King	39	-	NA	19	332.1 (136.7)	20	311.5 (153.4)
	KFC	83	-	NA	73	562.9 (240.1)	10	309.5 (81.1)
	Leon	25	-	NA	10	209.3 (65.0)	15	270 (81.0)
	McDonalds	23	-	NA	6	216.3 (167.1)	17	242 (115.5)
	Subway	5	-	NA	1	705 (-)	4	213.8 (2.2)
	Wimpy	20	-	NA	12	282.2 (168.8)	8	456.3 (230.2)
			-					
	Fast-food restaurants (N=6) ^b	195	-	NA	121	453.6 (249.7)	74	297.2 (142.4)
	n (%) >600kcal	NA	-	NA	40 (33.1)		3 (4.1)	
Full-service	all bar one	11	-	NA	6	447.7 (140.0)	5	587.2 (222.6)
	Ask	89	27	565.7 (278.0)	9	315.2 (336.1)	53	273.2 (137.3)
	Bills	33	19	318.9 (123.4)	5	265.4 (161.7)	9	535.4 (298.2)
	Chef and Brewer	39	8	481.1 (124.8)	13	302.6 (213.4)	18	486.1 (300.3)
	Ember Inns	29	7	307.6 (102.9)	8	206.1 (135.2)	14	522.2 (135.1)
	Flaming Grill	26	4	644.8 (111.4)	14	459.4 (233.9)	8	767.1 (343.7)
	Harvester	34	14	424.5 (119.2)	9	254 (148.7)	11	670.9 (156.2)
	Hungry horse	44	18	660.2 (247.5)	16	454.3 (280.0)	10	867.9 (517.6)
	JD Wetherspoons	24	-	NA	14	406.1 (325.9)	10	571.3 (169.3)
	Nando's	40	6	486 (265.5)	24	365 (320.7)	10	330 (217.4)
	Old English Inn	87	11	433.5 (199.6)	10	364.4 (209.4)	66	408.3 (141.5)
	Pizza Express	49	11	379.5 (196.4)	3	328.7 (126.0)	35	467.8 (97.9)
	Pizza Hut	18	11	463.6 (107.7)	4	412.5 (158.2)	3	624.7 (82.7)
	Sizzling Pubs	36	13	477.7 (167.0)	10	391.6 (227.4)	13	723.5 (210.8)
	Slug and Lettuce	17	-	NA	7	754 (656.4)	9	400.9 (147.7)
	Stone house	33	18	622.6 (329.9)	2	88 (26.9)	13	686.4 (230.0)
	Table Table	30	9	455.9 (154.4)	12	303.3 (159.7)	9	519.3 (223.1)
	Toby's Carvery	33	10	423.3 (134.3)	-	-	23	671.5 (251.2)
Vintage Inns	27	9	357.7 (271.9)	8	239.5 (206.7)	10	738.9 (345.9)	
Wagamama	35	-	NA	21	326 (120.1)	14	354 (115.8)	
Zizzi	81	17	575.6 (155.1)	1	222 (-)	63	246.5 (150.0)	
	Full-service restaurants (N=21) ^b	815	212	488 (227.7)	196	362.9 (270.0)	406	430.5 (251.3)
	n (%) >600kcal		56 (26.4)		29 (14.8)		95 (23.4)	

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3 ^b For descriptive purposes, values in this row represent the mean (SD) of individual restaurant
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5 values for mean kcals per dish
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8 - indicates absence of dish from restaurant chain menu
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Table 2. Kilocalorie content of chips/fries and ice-cream dishes from eligible restaurant chains included in analyses

Restaurant chain	N	Chips/Fries		Ice-cream	
		Mean kcal per serving (SD)	N	Mean kcal per serving (SD)	
Burger King	4	342.5 (113.2)	6	168.3 (80.6)	
KFC	2	372.5 (95.5)	4	253.8 (94.2)	
Leon	2	174.0 (-)	-	-	
McDonalds	3	339.3 (103.5)	10	211.0 (76.6)	
Subway	-	-	-	-	
Wimpy	2	267.5 (0.7)	4	397.3 (252.5)	
Fast-food chains ^b	13	308.9 (101.7)	24	238.5 (138.6)	
All bar one	1	505.0 (-)	-	-	
Ask	-	-	17	268.8 (71.4)	
Bills	2	429.5 (113.8)	1	107.0 (-)	
Chef and Brewer	3	478.7 (133.5)	1	951.0 (-)	
Ember Inns	-	-	1	338.0 (-)	
Flaming Grill	1	546.0 (-)	1	1421.0 (-)	
Harvester	2	469.5 (47.4)	-	-	
Hungry horse	3	530 (112.9)	3	1223.7 (903)	
JD Wetherspoons	1	955.0 (-)	-	-	
Nando's	3	680.3 (503.8)	4	140.5 (28.5)	
Old English Inn	1	764.0 (-)	12	498.5 (197.1)	
Pizza Express	-	-	-	-	
Pizza Hut	2	493.5 (195.9)	21	438.0 (79.8)	
Sizzling Pubs	1	503.0 (-)	5	688.8 (286)	
Slug and Lettuce	1	1187.0 (-)	-	-	
Stone house	1	107.0 (-)	1	800.0 (-)	
Table Table	3	347.3 (17.2)	3	444.3 (263.6)	
Toby's Carvery	-	-	4	559 (147.2)	
Vintage Inns	2	493.5 (13.4)	-	-	
Wagamama	-	-	6	388.5 (104.6)	
Zizzi	-	-	24	266.9 (147.4)	
Full-service chains ^b	27	535.1 (254.1)	104	416.8 (289.2)	

^b For descriptive purposes, values in this row represent the mean (SD) of individual restaurant values for mean chips/fries dishes kcals and mean ice-creams dishes kcals

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BMJ Open

A bit or a lot on the side? An observational study of the energy content of starters, sides and desserts in major UK restaurant chains

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Primary Subject Heading:	Health policy
Secondary Subject Heading:	Public health
Keywords:	food environment, eating out, restaurant food, kilocalories, obesity

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3 22 **Abstract**

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5 23 Objectives: Our objective was to examine the kilocalorie (kcal) content of starters, sides and
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7 24 desserts served in major UK restaurant chains, comparing the kcal content of these dishes in
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9 25 fast-food and full-service restaurants.

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12 26 Design: Observational study.

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14 27 Setting: Menu and nutritional information provided online by major UK restaurant chains.

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16 28 Method: During October to November 2018, we accessed websites of restaurant chains with
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18 29 50 or more outlets in the UK. Menu items that constituted starters, sides or desserts were
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20 30 identified and their kcal content was extracted. Accompanying beverages were not included.

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22 31 We used multilevel modelling to examine whether mean kcal content of dishes differed in
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24 32 fast-food vs. full-service restaurants.

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26 33 Main outcome measures: The mean kcal content of dishes and the proportion of dishes
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28 34 exceeding public health recommendations for energy content in a main meal (>600kcal).

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30 35 Results: A total of 1009 dishes (212 starters, 318 sides and 479 desserts) from 27 restaurant
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32 36 chains (21 full-service, 6 fast-food) were included. The mean kcal content of eligible dishes
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34 37 was 488.0 (SE=15.6) for starters, 397.5 (SE=14.9) for sides and 430.6 (SE=11.5) for desserts.

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36 38 The percentage of dishes exceeding 600kcal was 26.4% for starters, 21.7% for sides and
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38 39 20.5% for desserts. Compared to fast-food chains, desserts offered at full-service restaurants
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40 40 were on average more calorific and were significantly more likely to exceed 600kcal.

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42 41 Conclusions: The average energy content of sides, starters and desserts sold in major UK
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44 42 restaurants is high. One in four starters and one in five sides and desserts in UK chain
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46 43 restaurants exceed the recommended energy intake for an entire meal.

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3 45 **Strengths and limitations of this study**
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- 5 46 • This is the first study of which we are aware to assess the energy content of starters,
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7 sides and desserts in the UK eating out sector.
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10 48 • Our findings will be of use to future evaluations of how the out of home food sector
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12 respond to voluntary or mandatory public health actions through food product
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14 reformulation.
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17 51 • Smaller chains and independent restaurants were not included, however studies
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19 indicate that chain and non-chain restaurants tend to serve highly calorific foods.
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22 53 • We could only use the nutrition data that restaurants made available, which excluded
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24 several dishes from our analyses.
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55 Introduction

56 Overweight and obesity are now common in most of the developed world. For example, in
57 the UK two in three adults and one in three children are now classed as having overweight or
58 obesity ¹. Although obesity is a multifactorial disease, it is clear that changes to the food
59 environment have been a key factor driving the global obesity epidemic ^{2,3}. Eating out of the
60 home is becoming increasingly common, with 39% of adults reporting eating out at least
61 once a week in a recent UK study ⁴. Eating out of the home is associated with higher energy
62 consumption and research suggests that frequently eating out of the home is a risk factor for
63 obesity ⁵. The consumption of 'fast-food' meals has been widely identified as a cause for
64 concern, due to the low nutritional quality and high energy content of meals served in these
65 restaurants ⁶. Because of this, the out of home food sector has now been identified as an area
66 for public health policy intervention in the US ⁷ and UK government are currently
67 considering similar policy action ⁸. However, most of the research on the nutritional quality
68 of food eaten out of the home has been conducted in North America, a region with a
69 particularly high prevalence of obesity ^{6,9,10}. There has been little research examining the
70 nutritional quality of food sold out of the home in the UK, although a small study of meals
71 sold in independent small scale takeaway outlets has shown that energy content can be
72 excessive ¹¹. In a recent study we examined the kilocalorie content of main meals sold by
73 major restaurant chains in the UK ¹². We found that the average kilocalorie content of main
74 meals was high and very few meals adhered to public health recommendations for main meal
75 kilocalorie consumption (≤ 600 kcal) recently suggested by Public Health England ¹³.
76 Moreover, we found that main meals sold by full-service restaurants tended to be more
77 calorific than those sold by fast-food restaurants, which is consistent with data from North
78 American restaurants ¹⁴. However, previous research has focused on main meals and
79 consumers eating out can be offered a choice of starters, sides and/or desserts on restaurant
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3 80 menus. The aim of the present study was to assess the average energy content of starters,
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5 81 sides and desserts sold in major UK restaurant chains. Based on Robinson et al. (2018)¹², we
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7 82 also examined how common it was for starters, sides and desserts to exceed the amount of
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9 83 calories recommended for an entire meal and whether these dishes were more calorific at full-
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11 84 service, as opposed to fast-food restaurants.
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15 85 **Methods**

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17 86 This is an observational study of the energy content of menu items across large chain
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19 87 restaurants in the UK. We pre-registered the study protocol and analysis plan on the Open
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21 88 Science Framework (<https://osf.io/6cfdb/>).

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24 89 *Patient and Public Involvement.* No patients or public were involved in this study.

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27 90 *Restaurant sampling.* Previously¹² we identified restaurant chains with ≥ 50 outlets in the
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29 91 UK by consulting market reports listing restaurants with the largest number of UK outlets,
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31 92 and market research ranking UK restaurant chains by annual turnover, popularity, number of
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33 93 users, and numbers of outlets¹⁵⁻¹⁸. If the number of UK outlets was not provided on a
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35 94 restaurant website, this information was requested by email.

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38 95 *Characterising restaurant types.* As in Robinson et al. (2018)¹² we classified restaurant
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40 96 chains as ‘fast-food’ or ‘full-service’ restaurants using the following definition of fast-food
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42 97 restaurants: ‘Restaurants that primarily provide consumers with largely pre-prepared ‘quick’
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44 98 meals with little or no table service, with in-store seating and in which take-away orders are
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46 99 likely to account for a significant proportion of orders’. We classified full-service chains as
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48 100 restaurants where consumers primarily order and are served while seated at a table¹⁹.

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51 101 Therefore, coffee shops and take-away only outlets were not considered eligible. Previously
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53 102 two researchers independently categorised each of the included restaurant as fast-food or full-
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55 103 service with any disagreements resolved by a third researcher¹².
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3 104 *Data sources.* To access current menus and nutritional information, two researchers visited
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5 105 the restaurants' UK web pages during October and November 2018 and accessed online
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7 106 versions of current menus. If a specific geographical location was required to access a
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9 107 restaurant chain menu we chose London (largest city in the UK) and the first listed location.
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11 108 If a restaurant only had a downloadable menu (PDF), and no website menu, we used the
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13 109 former. If there were several menus (e.g. specials menus), only the 'main menu' was used for
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15 110 coding. If there was no menu clearly labelled as the 'main' menu then we used the
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17 111 restaurant's 'evening menu'.

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21 112 *Starters, sides, desserts menu options.* We examined the kcal content of starters, sides and
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23 113 dessert menu options. We defined a starter/side/dessert item as being a menu option that is
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25 114 not a main meal dish, is an individually sold food item and can be ordered on its own, as
26
27 115 opposed to a more specific addition to a menu item (e.g. steak sauce, ice cream toppings). We
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29 116 excluded menu items that could not be ordered by all consumers (e.g. items from senior
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31 117 citizens menu section, children's menu section) and excluded platters and sharers (unless the
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33 118 menu indicated the number of people per serving) as we could not confidently identify what
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35 119 combination of sharing menu options would constitute a starter, side or dessert for one
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37 120 person. Small plates (tapas) were not eligible unless they were part of a section of the menu
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39 121 that was labelled as starters, sides or desserts. We also excluded menu items with unspecified
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41 122 portion size, such as "unlimited" or "bottomless" options as we would not be able to calculate
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43 123 energy content. In instances in which a menu option could be customized at the request of the
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45 124 patron for an additional charge (for example add extra toppings), we only extracted the
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47 125 default composition of the menu option. In instances in which a menu option required a
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49 126 customer to make an explicit choice (e.g. choice of topping for a starter or dessert
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51 127 accompaniment), we identified all possible configurations for the item and recorded each as
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53 128 an individual menu item (e.g. chocolate cake with ice cream, chocolate cake with custard). If
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3 129 a menu item appeared on the menu as served with a drink of choice, we excluded it as a
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5 130 scoping exercise indicated that this was uncommon and our focus is on energy content of
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8 131 food items. Finally, to minimize effects of season, we only included options that were
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10 132 available all year round and sold everyday (e.g. we excluded dishes sold only on specific
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12 133 days, such as ‘soup of the day’).

14 134 Two researchers independently identified menu options from each restaurant and a third
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16 135 researcher checked their eligibility according to the protocol and resolved any discrepancies
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18 136 (October 2018). If menu sections were not specifically labelled as starters, sides or desserts,
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20 137 researchers categorised individual menu items according to the menu section they would
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22 138 typically be found under in UK restaurants. If there was a disagreement between two
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24 139 researchers a third researcher made the final decision. As there was a very high number of
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26 140 menu sections that were not eligible (e.g. main meals, sharers, drinks, children’s menu,
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28 141 Sunday menu) researchers did not record a classification (eligible vs. not eligible) for every
29
30 142 item on each menu. As in Robinson et al (2018)¹² we used an approximated inter-coder
31
32 143 consistency by calculating the number of menu items deemed eligible by both researchers vs.
33
34 144 the number of menu items included by only one of the researchers.

35
36 145 Because variability in menu item kcal content between restaurant types may be in part
37
38 146 explained by the two types of restaurant serving different types of dishes we examined
39
40 147 whether there were dishes that were routinely sold by both types of restaurant (e.g. side of
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42 148 fries/chips, salad) and compared the average number of kcals for these dishes by restaurant
43
44 149 type. Since the names of the same dishes could vary between menus, coding of these items
45
46 150 was completed by one researcher and cross-checked by a second researcher.

47
48 151 *Extraction of dish kcal content.* Two researchers accessed the online nutritional information
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50 152 for each restaurant (November 2018) and extracted the number of kcals per menu item. A
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52 153 third researcher independently cross-checked kcal extraction for accuracy.

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154 **Statistical analysis**

155 *Primary analyses – average number of kcals:* Menu items were nested within individual
156 restaurants so we planned to use multi-level analyses (levels: menu item, restaurant) with
157 random intercept at the restaurant level and fixed slopes. We first examined if a multi-level
158 analysis was appropriate for starters, sides and dessert kcals separately by examining the
159 portioning of variance attributed to differences in kcals between restaurants (between
160 restaurant variance/ (between restaurant variance + within restaurant variance)). We
161 examined the multilevel model fit by comparing the loglikelihood ratio statistic
162 (loglikelihood of the multilevel model - loglikelihood of the single-level model) to a chi-
163 squared distribution with 1 degree of freedom. We used bootstrapping (500 samples) to
164 improve the accuracy of parameter values and reduce bias in parameter estimates. Statistical
165 significance ($p < .05$) indicated meaningful variation in kcals of menu items between
166 restaurants and a multilevel model was used. In all statistical tests α was set at .05 and we
167 report 95% confidence intervals for significance testing. Where multilevel modelling was not
168 appropriate we used conventional frequentist statistics, maintaining $p < .05$ as the level of
169 statistical significance.

170 *Secondary analyses.* Public Health England recommends that adults do not exceed 600kcal
171 for a complete meal at lunch and dinner¹³. There are no specific recommendations for
172 individual components (e.g. energy from sides) of a meal, so we examined how common it
173 was for starters, sides and desserts to be excessive in kcal content by calculating the
174 proportion of menu items that exceed an entire meal's worth of kcals (600kcal). We
175 examined differences between the two restaurant types (fast-food vs. full-service) by using a
176 multi-level binary logistic regressions when appropriate.

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Results

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3 179 *Restaurants.* Fifty-two eligible restaurant chains were identified and of these 30 restaurants
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5 180 had available menus and nutritional information. We requested this from the remaining
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7 181 chains but only one provided this information. Because we examined main meal
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9 182 accompaniments (starters, sides, desserts) we excluded four restaurants that only tended to
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11 183 sell individual food items that customers choose from to form a meal (e.g. pieces of chicken,
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13 184 pieces of sushi) leaving 27 restaurants in the final sample (n=6 fast-food, n=21 full-service
14
15 185 restaurants). See Table 1 for restaurants included.
16
17 186 *Menu items.* Of all the menu items identified by either of two coders (1494), the first coder
18
19 187 identified 74 items which were not identified by the second coder (95.1% agreement) and the
20
21 188 second coder identified 35 items not identified by the first coder (97.7% agreement),
22
23 189 indicating reasonable consistency between the two coders in identifying eligible dishes. The
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25 190 items in disagreement were then reviewed by a third researcher and after these discrepancies
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27 191 were resolved, the final number of eligible dishes was 1361. We were able to extract kcal
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29 192 information for 1009 dishes (74.1% of eligible items) and the remaining dishes were treated
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31 193 as missing data and not included in analyses. The missing information for the 25.9% of the
32
33 194 items was due to lack of nutritional information provided by restaurants. See Table 1 for
34
35 195 number of eligible dishes per restaurant.
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37 196 *Mean kcal content of menu items (Table 1).* For all three groups (starters, sides and desserts)
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39 197 two-level model (dishes within restaurants) was a better fit of the data than a single level
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41 198 model. The variance partition coefficient; the total residual variance which is attributable to
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43 199 restaurants rather than individual dishes was 14.7% (model fit: $\chi^2(1) = 18.1, p < .001$) for
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45 200 starters, 13.8% (model fit: $\chi^2(1) = 35.0, p < .001$) for sides, and 45.0% (model fit: $\chi^2(1) =$
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47 201 197.5, $p < .001$) for desserts, indicating that multi-level modelling was appropriate. In a one-
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49 202 level model (for the descriptive purposes), the average number of kcals for starters was 488.0
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51 203 (SE=15.6), for sides was 397.5 (SE=14.9) and for desserts was 430.6 (SE=11.5).
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3 204 Next, we used a two-level model to compare the average number of kcal in sides and in
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5 205 desserts between fast-food and full-service restaurants, as there were no starters identified in
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7 206 the fast-food restaurants. Type of restaurant (fast-food vs. full-service) was not a significant
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9 207 predictor of kcal content for sides ($\beta = 0.1$, $SE = 2.8$ (95% CIs -5.5 to 5.6), $p = .49$) indicating
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11 208 that sides offered at fast-food restaurants had on average only 0.1 kcals more energy than
12
13 209 sides from fast-food restaurants. Desserts had on average 241.2 more kcal in full-service than
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15 210 in fast-food chains ($\beta = 241.2$, $SE = 65.4$ (95% CIs 113.0 to 369.4), $p = .001$) and this
16
17 211 difference was statistically significant.

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19 212 *Mean kcal content of specific dish types (Table 2).* The most common side available was
20
21 213 chips/fries. To compare the average kcal content of chips between the fast-food and full-
22
23 214 service restaurants we selected only chips/fries menu options that were made of potato, plain,
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25 215 with no sauces or spices, toppings or extras and were served as sides. The inclusion criteria
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27 216 resulted in 40 eligible menu items, offered in 19 restaurants (out of the 27), including five out
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29 217 of six fast-food chains (n=13 items), and 14 out of 21 full-service chains (n=27 items). The
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31 218 small number of items eligible for this sub-analysis did not lend itself to multilevel analysis
32
33 219 so we used Welch's t-test to compare the types of restaurants. The average number of kcals
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35 220 was 441.9 (SE=33.1) across all restaurants. Chips/fries in full-service restaurants had on
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37 221 average 197.0 kcals more than in fast-food restaurants (505.9 kcal vs 308.9kcal) and this
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39 222 difference was statistically significant ($t(38) = 3.9$, $p < .01$, $d = 1.2$). Ice-cream dishes were
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41 223 the most frequently served dessert across restaurants. We selected only ice-creams made of
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43 224 dairy cream, therefore items such as sorbets, vegan ice creams (or combinations of flavours
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45 225 including either of these), and other desserts that included ice-cream (such as cake with ice
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47 226 cream) were excluded from the comparison. Ice-creams were served in 19 out of 27
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49 227 restaurants (4 of 6 fast-foods and 15 of 21 full-service), with a total of 114 items (24 in fast
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51 228 foods and 90 in full-service). The average amount of kcals in ice-cream dishes was 389.2
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3 229 (SE=27.1). Full-service restaurant ice-cream dishes had on average 190.9 kcals more than
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5 230 fast-food ice-cream dishes (429.4kcal vs. 238.5kcal) and this difference was statistically
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7 231 significant ($t(85) = 4.5, p < .001, d = 0.8$).

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10 232 *Menu items >600kcal*. Of the 212 starters identified, 56 (26.4%) exceeded 600kcal per dish
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12 233 and all starters were from full-service restaurants. Of the 318 sides, 69 (21.7 %) had
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14 234 >600kcal. Multi-level logistic regression models demonstrated the proportion of sides
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16 235 >600kcal was not significantly larger in fast-food restaurants compared to full service
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18 236 restaurants (Wald statistic (1) = 4.32, $p = .04$ OR = 1.52 (95% CIs: 0.14 to 16.10), $p = .48$).

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20 237 Among the 479 identified desserts, 98 (20.5 %) exceeded 600kcal. A multi-level logistic
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22 238 regression model demonstrated that the proportion of desserts exceeding the 600kcal was 14
23
24 239 times larger in full-service compared to fast food restaurants (Wald statistic (1) = 7.7, $p < .01$;
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26 240 OR = 14.01 (95% CIs 1.95 to 101.49), $p < .01$).

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35 242 Discussion

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37 243 The present study examined the energy content of starters, sides and desserts sold by major
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39 244 UK restaurant chains. We found that the average number of kilocalories in starters, sides and
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41 245 desserts was 488.0 (SE=15.6), 397.5 (SE=14.9) and 430.6 (SE=11.5) kilocalories
42
43 246 respectively. We also examined the proportion of these dishes that we deemed to be
44
45 247 'excessive' by identifying those with more than 600 kilocalories; the recommended
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47 248 kilocalorie content of a full lunch or dinner meal in the UK²⁰. We identified that one in four
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49 249 starters and one in five sides and desserts exceeded the amount of energy recommended for a
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51 250 full meal. Results also indicated that kilocalorie content of dishes was associated with
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53 251 restaurant type. When comparing types of restaurants, we found that desserts were
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55 252 significantly higher in kilocalories in full-service vs. fast-food restaurants.
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6 254 Our results are in line with studies that have examined the energy content of North American
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8 255 restaurant food and a recent UK study finding an excessive number of kilocalories in menu
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10 256 items in the eating-out sector and a general trend for full-service restaurant menu items to on
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12 257 average be more calorific than fast-food restaurants^{10 12 14 21-23}. Based on the results from our
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15 258 current study and the previous UK study of main meals¹², the average energy content of a
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17 259 three-course meal (starter, main meal, dessert, without the addition of an extra side) in a
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19 260 major chain restaurant in the UK would be approximately 1,896 kilocalories, which equates
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21 261 to over three times the recommended energy intake for a main meal, and 95% of the
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23 262 recommended daily consumption of kilocalories for women or 76% for men. Although
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25 263 individual energy requirements vary according to levels of physical activity, age, gender, and
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27 264 body mass, frequent eating out of home combined with the relatively high energy content of
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29 265 restaurant dishes (including starters, sides and desserts) may contribute to excessive energy
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31 266 intake that is now common in the UK and other high-income countries. The present research
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33 267 has relevance to public health policy and our results also suggest that policy actions which
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35 268 result in the reduction of the energy content of restaurant food are urgently needed. In
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37 269 September 2018, the UK government launched an open consultation on kilocalorie labelling
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39 270 for food and drink served outside of the home. As our study shows, starters, sides and
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41 271 desserts can be highly calorific and, in some cases, exceed the amount of energy
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43 272 recommended for a single meal. A recently published study performed two meta-analyses to
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45 273 study the effect of menu energy labelling on consumer choice and the energy content of menu
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47 274 items. It showed that there was a reduction in kilocalories ordered by consumers and a
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49 275 reduction in energy content of menu items provided by restaurants when the energy content
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51 276 of meals was displayed at the point-of-choice.²⁴ Thus, this research supports the proposition
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53 277 that menu labelling may benefit public health through two main channels; industry
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3 278 reformulation and individual behaviour change.²⁵ Given that kilocalorie labelling is only
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5 279 likely to have a small effect on daily energy intake, a combination of this and other
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8 280 population-wide interventions will be required to improve diet and reduce obesity.
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12 282 We also found a high degree of variability in kilocalorie content in similar dishes across
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14 283 restaurants, which may make it difficult for consumers to estimate energy content without
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16 284 access to nutritional information. For example, the most calorific portion of chips/fries
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18 285 offered in studied restaurant chains had nearly 12 times more than the least calorific (107kcal
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20 286 and 1256kcal) and it was common for ice-cream desserts to vary dramatically in kilocalorie
21
22 287 content. Although due to the methodological challenges, we did not include smaller chains or
23
24 288 independent restaurants in our study, evidence from US studies suggests that both chain and
25
26 289 non-chain restaurants tend to serve highly calorific foods¹⁰. Therefore, mandatory
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28 290 kilocalorie labelling in the UK out of home food sector would be appropriate. The present
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30 291 study is the first of which we are aware of that assesses the energy content of starters, sides
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32 292 and desserts in the UK eating out sector, and the results may be of use to future evaluations of
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34 293 how the out of home food sector respond to voluntary or mandatory public health actions
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36 294 through food product reformulation.
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45 296 *Limitations*

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47 297 As there are no guidelines for the limits of calories in different courses of the meal, we
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49 298 examined the proportion of meals exceeding Public Health England's recommendation of
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51 299 600 kcals or less per entire meal (lunch or dinner). A further limitation of the study was that
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53 300 we were only able to make use of nutrition data from restaurants that made this information
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55 301 available, which excluded several dishes and restaurants from our analyses. This presents a
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57 302 potential source of bias if the kilocalorie content of restaurants that do not provide nutrition
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3 303 information differs to that of restaurants that do. It is also possible that restaurant-provided
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5 304 nutrition information is inaccurate, although research suggests that any inaccuracy may be
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8 305 relatively small ²⁶.
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307 *Conclusions*

308 The energy content of sides, starters and desserts sold in major UK restaurants is high. One in
309 four starters and one in five sides and desserts in UK chain restaurants exceed the
310 recommended energy intake for an entire meal.
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312 **Data Sharing**

313 The final data sets containing restaurant dishes' descriptions and number of kcals for each
314 restaurant used in analyses are available online at <https://osf.io/cd597/>
315

316

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319

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321 All authors have completed the ICMJE uniform disclosure form at
322 www.icmje.org/coi_disclosure.pdf. ER has been a named investigator on research projects
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1
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5 324 interest.

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12 326 **Author statement and Contribution**

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15
16 327 ER and MM designed the study. MM, CR, FS contributed to data collection. AH provided an
17
18 328 advice and expertise at all stages and helped solving eligibility disagreements. AJ and MM
19
20 329 were responsible for data analysis. MM was responsible for initial drafting of the paper and
21
22 330 all authors approved the manuscript and had full access to the data.

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27 332 **Ethical approval**

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29 333 As the study involved no human or animal participants and made use of publicly available
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31 334 information ethical approval was not required

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36 336 **Transparency**

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39 337 MM acts as the guarantor for this work and confirms that the manuscript is an accurate,
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41 338 transparent and honest account of the study, that no important aspects of the study have been
42
43 339 omitted and that any discrepancies from the study as planned have been explained.

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49 341 **References**

- 50
51 342 1. Health matters: obesity and the food environment. 2018.
52
53 343 [https://www.gov.uk/government/publications/health-matters-obesity-and-the-food-](https://www.gov.uk/government/publications/health-matters-obesity-and-the-food-environment/health-matters-obesity-and-the-food-environment--2)
54
55 344 [environment/health-matters-obesity-and-the-food-environment--2.](https://www.gov.uk/government/publications/health-matters-obesity-and-the-food-environment/health-matters-obesity-and-the-food-environment--2)
56
57
58
59
60

- 1
2
3 345 2. Livingstone MBE, Pourshahidi LK. Portion Size and Obesity. *Adv Nutr* 2014; **5**(6):
4
5 346 829-34.
- 6
7
8 347 3. MacKay S. Legislative solutions to unhealthy eating and obesity in Australia. *Public*
9
10 348 *Health* 2011; **125**(12): 896-904.
- 11
12 349 4. Adams J, Goffe L, Brown T, et al. Frequency and socio-demographic correlates of
13
14 350 eating meals out and take-away meals at home: cross-sectional analysis of the UK national
15
16 351 diet and nutrition survey, waves 1–4 (2008–12). *Int J Behav Nutr Phys Act* 2015; **12**(1): 51.
- 17
18
19 352 5. Bowman SA, Vinyard BT. Fast Food Consumption of U.S. Adults: Impact on Energy
20
21 353 and Nutrient Intakes and Overweight Status: *J Am Coll Nutr*. 23 (2) (pp 163-168), 2004. Date
22
23 354 of Publication: April 2004.; 2004.
- 24
25
26 355 6. Bauer KW, Hearst MO, Earnest AA, French SA, Oakes JM, Harnack LJ. Energy
27
28 356 content of U.S. fast-food restaurant offerings: 14-year trends. *Am J Prev Med* 2012; **43**(5):
29
30 357 490-7.
- 31
32
33 358 7. Rubin R. Will Posting Nutritional Information on Menus Prod Diners to Make
34
35 359 Healthier Choices? *JAMA* 2018; **319**(19): 1969-71.
- 36
37
38 360 8. Calorie labelling for food and drink served outside of the home. 2018.
39
40 361 <https://www.gov.uk/government/consultations/calorie-labelling-for-food-and-drink-served->
41
42 362 [outside-of-the-home](https://www.gov.uk/government/consultations/calorie-labelling-for-food-and-drink-served-outside-of-the-home).
- 43
44
45 363 9. Urban LE, Lichtenstein AH, Gary CE, et al. The energy content of restaurant foods
46
47 364 without stated calorie information. *JAMA Intern Med* 2013; **173**(14): 1292-9.
- 48
49 365 10. Urban LE, Weber JL, Heyman MB, et al. Energy contents of frequently ordered
50
51 366 restaurant meals and comparison with human energy requirements and US Department of
52
53 367 Agriculture database information: a multisite randomized study. *J Acad Nutr Diet* 2016;
54
55 368 **116**(4): 590-8. e6.
- 56
57
58 369 11. Jaworowska A, M. Blackham T, Long R, et al. *Nutr Food Sci* 2014; **44**(5): 414-30.
59
60

- 1
2
3 370 12. Robinson E, Jones A, Whitelock V, R. Mead B, Haynes A. (Over)eating out at major
4
5 371 UK restaurant
6
7
8 372 chains: observational study of energy content of main meals. *BMJ* 2018.
9
10 373 13. [https://www.gov.uk/government/news/plans-to-cut-excess-calorie-consumption-](https://www.gov.uk/government/news/plans-to-cut-excess-calorie-consumption-unveiled)
11
12 [unveiled.](https://www.gov.uk/government/news/plans-to-cut-excess-calorie-consumption-unveiled)
13 374
14
15 375 14. Scourboutakos MJ, L'Abbe MR. Restaurant menus: calories, caloric density, and
16
17 376 serving size. *Am j prev med* 2012; **43**(3): 249-55.
18
19 377 15. Mintel. Mintel Market Sizes, Restaurants in UK(2017). Report accessed via
20
21 378 University of Liverpool Library, Liverpool, UK. March 2018.
22
23 379 16. Mintel. Mintel Market Sizes, Fast-food and Takeaways in UK (2016). Report
24
25 380 accessed via University of Liverpool Library, Liverpool, UK. Accessed 1st March 2018
26
27 381 17. Statista. Leading restaurant chains ranked by number of users in the United Kingdom
28
29 382 (UK) from 2017. 2017. Report accessed 1st March from
30
31 383 [https://www.statista.com/statistics/586234/restaurant-chains-usage-in-the-uk-by-number-of-](https://www.statista.com/statistics/586234/restaurant-chains-usage-in-the-uk-by-number-of-users/)
32
33 [users/](https://www.statista.com/statistics/586234/restaurant-chains-usage-in-the-uk-by-number-of-users/)
34 384
35
36 385 18. Statista. Leading restaurant chains ranked by number of users in the United Kingdom
37
38 386 (UK) from 2017. 2017. Report accessed 1st March from
39
40 387 [https://www.statista.com/statistics/586234/restaurant-chains-usage-in-the-uk-by-number-of-](https://www.statista.com/statistics/586234/restaurant-chains-usage-in-the-uk-by-number-of-users/)
41
42 [users/](https://www.statista.com/statistics/586234/restaurant-chains-usage-in-the-uk-by-number-of-users/)
43 388
44
45 389 19. Mazidi M, State Key Laboratory of Molecular Developmental Biology IoGaDB,
46
47 390 Chinese Academy of Sciences, Chaoyang, Beijing, China, University of the Chinese
48
49 391 Academy of Sciences H, Beijing, China, et al. Higher densities of fast-food and full-service
50
51 392 restaurants are not associated with obesity prevalence. *AJCN* 2019;**106**(2):603-13. doi:
52
53 393 10.3945/ajcn.116.151407
54
55 394 20. PHE. Calorie reduction: the scope and ambition for action. 2018.
56
57
58
59
60

- 1
2
3 395 21. Bleich SN, Wolfson JA, Jarlenski MP, Block JP. Restaurants with calories displayed
4
5 396 on menus had lower calorie counts compared to restaurants without such labels. *Health aff.*
6
7 397 2015 Nov 1;**34**(11):1877-84.
- 8
9 398 22. Auchincloss AH, Leonberg BL, Glanz K, Bellitz S, Ricchezza A, Jervis A. Nutritional
10
11 399 value of meals at full-service restaurant chains. *J Nutr Educ Behav* 2014; **46**(1): 75-81.
- 12
13 400 23. Schoffman DE, Davidson CR, Hales SB, et al. The Fast-Casual Conundrum: Fast-
14
15 401 Casual Restaurant Entrees Are Higher in Calories than Fast Food. *J Acad Nutr Diet*
16
17 402 2016;**116**(10):1606-12. doi: 10.1016/j.jand.2016.03.020 [published Online First: 2016/05/18]
- 18
19 403 24. Zlatevska N, Neumann N, Dubelaar C. Mandatory Calorie Disclosure: A
20
21 404 Comprehensive Analysis of Its Effect on Consumers and Retailers. *Journal of Retailing*
22
23 405 2018;Volume **94**(Issue 1):89-101. doi: <https://doi.org/10.1016/j.jretai.2017.09.007>
- 24
25 406 25. Roberts S, Pilard L, Chen J, et al. Efficacy of population-wide diabetes and obesity
26
27 407 prevention programs: An overview of systematic reviews on proximal, intermediate, and
28
29 408 distal outcomes and a meta-analysis of impact on BMI. *Obes Rev* 2019;**20**(7):947-63. doi:
30
31 409 10.1111/obr.12821 [published Online First: 2019/05/01]
- 32
33 410 26. Urban LE, McCrory MA, Dallal GE, et al. Accuracy of Stated Energy Contents of
34
35 411 Restaurant Foods. *JAMA* 2011; **306**(3): 287-93.
- 36
37
38
39
40
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Table 1. Kilocalorie content of dishes from eligible restaurant chains included in analyses

Restaurant type	Restaurant chain name	N	Starters		Sides		Desserts	
			Number	Mean (SD) kcals	Number	Mean (SD) kcal per dish	Number	Mean (SD) kcals
Fast-food	Burger King	39	-	NA	19	332.1 (136.7)	20	311.5 (153.4)
	KFC	83	-	NA	73	562.9 (240.1)	10	309.5 (81.1)
	Leon	25	-	NA	10	209.3 (65.0)	15	270.0 (81.0)
	McDonalds	23	-	NA	6	216.3 (167.1)	17	242.0 (115.5)
	Subway	5	-	NA	1	705.0 (-)	4	213.8 (2.2)
	Wimpy	20	-	NA	12	282.2 (168.8)	8	456.3 (230.2)
	All fast-food restaurants (N=6) ^a	195	-	NA	121	453.6 (249.7)	74	297.2 (142.4)
n (%) >600kcal ^b	NA	-	NA	40 (33.1)		3 (4.1)		
Full-service	all bar one	11	-	NA	6	447.7 (140.0)	5	587.2 (222.6)
	Ask	89	27	565.7 (278.0)	9	315.2 (336.1)	53	273.2 (137.3)
	Bills	33	19	318.9 (123.4)	5	265.4 (161.7)	9	535.4 (298.2)
	Chef and Brewer	39	8	481.1 (124.8)	13	302.6 (213.4)	18	486.1 (300.3)
	Ember Inns	29	7	307.6 (102.9)	8	206.1 (135.2)	14	522.2 (135.1)
	Flaming Grill	26	4	644.8 (111.4)	14	459.4 (233.9)	8	767.1 (343.7)
	Harvester	34	14	424.5 (119.2)	9	254.0 (148.7)	11	670.9 (156.2)
	Hungry horse	44	18	660.2 (247.5)	16	454.3 (280.0)	10	867.9 (517.6)
	JD Wetherspoon	24	-	NA	14	406.1 (325.9)	10	571.3 (169.3)
Nando's	40	6	486.0 (265.5)	24	365.0 (320.7)	10	330.0 (217.4)	

Old English Inn	87	11	433.5 (199.6)	10	364.4 (209.4)	66	408.3 (141.5)
Pizza Express	49	11	379.5 (196.4)	3	328.7 (126.0)	35	467.8 (97.9)
Pizza Hut	18	11	463.6 (107.7)	4	412.5 (158.2)	3	624.7 (82.7)
Sizzling Pubs	36	13	477.7 (167.0)	10	391.6 (227.4)	13	723.5 (210.8)
Slug and Lettuce	17	-	NA	7	754 (656.4)	9	400.9 (147.7)
Stone house	33	18	622.6 (329.9)	2	88.0 (26.9)	13	686.4 (230.0)
Table Table	30	9	455.9 (154.4)	12	303.3 (159.7)	9	519.3 (223.1)
Toby's Carvery	33	10	423.3 (134.3)	-	-	23	671.5 (251.2)
Vintage Inns	27	9	357.7 (271.9)	8	239.5 (206.7)	10	738.9 (345.9)
Wagamama	35	-	NA	22	328.1 (117.6)	13	352.6 (120.4)
Zizzi	81	17	575.6 (155.1)	1	222.0 (-)	63	246.5 (150.0)
All full-service restaurants (N=21)	815	212	488.0 (227.7)	197	397.5 (265.3)	405	430.6 (251.5)
n (%) >600kcal ^a		56 (26.4)		29 (14.7)		95 (23.5)	

^a For descriptive purposes, values in this row represent the one-level mean (SD) of individual restaurant values for mean kcals per dish

^b the values presented in these rows are the numbers of the dishes exceeding the 600 kcal and their representation among the total meals identified (n (%))

- indicates absence of dish from restaurant chain menu.

Table 2. Kilocalorie content of chips/fries and ice-cream dishes from eligible restaurant chains included in analyses

Restaurant chain	N	Chips/Fries		Ice-cream	
		Mean kcal per serving (SD)	N	Mean kcal per serving (SD)	
Burger King	4	342.5 (113.2)	6	168.3 (80.6)	
KFC	2	372.5 (95.5)	4	253.8 (94.2)	
Leon	2	174.0 (-)	-	-	
McDonalds	3	339.3 (103.5)	10	211.0 (76.6)	
Subway	-	-	-	-	
Wimpy	2	267.5 (0.7)	4	397.3 (252.5)	
All fast-food restaurants ^a	13	308.9 (101.7)	24	238.5 (138.6)	
All bar one	2	452.0 (75.0)	-	-	
Ask	-	-	16	272.8 (72.0)	
Bills	2	429.5 (113.8)	1	107.0 (-)	
Chef and Brewer	3	478.7 (133.5)	1	951.0 (-)	
Ember Inns	-	-	1	338.0 (-)	
Flaming Grill	1	546.0 (-)	1	1421.0 (-)	
Harvester	2	469.5 (47.4)	-	-	
Hungry horse	3	530.0 (112.9)	3	1223.7 (903)	
JD Wetherspoon	1	955.0 (-)	-	-	
Nando's	3	680.3 (503.8)	4	140.5 (28.5)	
Old English Inn	1	764.0 (-)	12	498.5 (197.1)	
Pizza Express	-	-	11	481.1 (63.4)	
Pizza Hut	2	493.5 (195.9)	-	-	
Sizzling Pubs	1	503.0 (-)	5	688.8 (286)	

Slug and Lettuce	-	-	-	-
Stone house	1	107.0 (-)	1	800.0 (-)
Table Table	3	347.3 (17.2)	2	596.5 (9.2)
Toby's Carvery	-	-	4	559.0 (147.2)
Vintage Inns	2	493.5 (13.4)	-	-
Wagamama	-	-	5	412.0 (97.7)
Zizzi	-	-	23	270.5 (146.7)
All Full-service restaurants ^a	27	505.9 (219.2)	90	429.4 (289.4)

^a For descriptive purposes, values in this row represent the one-level mean (SD) of individual restaurant values for mean chips/fries dishes kcals and mean ice-creams dishes kcals

- indicates absence of dish from restaurant chain menu

(-) indicates absence of SD as only one eligible dish from restaurant

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract <u>1, 26</u> (b) Provide in the abstract an informative and balanced summary of what was done and what was found <u>23-43</u>
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported <u>56-80</u>
Objectives	3	State specific objectives, including any prespecified hypotheses <u>80-84</u>
Methods		
Study design	4	Present key elements of study design early in the paper <u>86-87</u>
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection <u>89-92</u>
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants <u>NA</u>
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable <u>88 (pre-registered protocol), 94-151</u>
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group <u>94-151</u>
Bias	9	Describe any efforts to address potential sources of bias <u>100-105, 132-142, 149-151</u>
Study size	10	Explain how the study size was arrived at <u>184-192</u>
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why <u>194-238</u>
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding <u>152-174</u> (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed <u>177-193</u> (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders <u>Table 1</u> (b) Indicate number of participants with missing data for each variable of interest <u>NA</u>
Outcome data	15*	Report numbers of outcome events or summary measures <u>194,210,230</u>

1			
2	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included <u>194-209</u>
3			
4			
5			
6			(b) Report category boundaries when continuous variables were categorized <u>168-</u>
7			<u>172</u>
8			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period <u>NA</u>
9			
10			
11	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses <u>210-238</u>
12			
13			
14	Discussion		
15	Key results	18	Summarise key results with reference to study objectives <u>240-250</u>
16	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias <u>294-302</u>
17			
18			
19	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence <u>252-292</u>
20			
21			
22			
23	Generalisability	21	Discuss the generalisability (external validity) of the study results <u>260-278</u>
24			
25	Other information		
26	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based <u>314-315</u>
27			
28			

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.