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# Nutritional adequacy of meals from an independent catering facility versus chain-restaurants for young adults

1

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18 **Word Count = 2,481 (word limit=3,000)**19 **Running Title:** Nutritional Quality of independent and chain restaurants20 **Key Words:** Public Health, Catering, nutrition, obesity21 **Conflict of interest:** The authors declare there is no conflict of interest.22 **Funding:** The first author received a scholarship from the Greek State Scholarship Foundation and  
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24

25

26 **Abstract (word count= 200, word limit=250)**

27

28 **Background/Objectives:** Eating out-of-home has been associated with the increasing prevalence of  
29 obesity. While some chain-restaurants provide nutritional information for their products, smaller  
30 independent catering facilities may not provide such information. The aim of this study was to  
31 assess the nutritional adequacy of meals provided to young adults at an independent catering facility  
32 and compare them with meals provided by chain-restaurants.

33 **Subjects/Methods:** Meals were analysed in 2014 in the UK in relation of nutrient provision to  
34 targets for macro- and micro-nutrients. One-way ANOVA was performed to compare menus  
35 between the restaurants included in the analyses.

36 **Results:** 2,056 meal-combinations were analysed, 210 from the student accommodation and 1,846  
37 from five largest national chain-restaurants. Mean (SD) nutritional content was; student  
38 accommodation: 1193(269)kcal, fat 52.0(22)g, saturated fat 24.5(14.5)g, protein 42.4(28.5)g,  
39 carbohydrate 117.0(30)g, chain-restaurants: 922(160)kcal, fat 40.0(9.7)g, saturated fat 14.5(5.8)g,  
40 protein 31.2(6.5)g, carbohydrate 104.2(16.6)g. Meals from the student accommodation presented  
41 significantly more calories than the meals in all five chain-restaurants ( $p=0.0015$ ).

42 **Conclusions:** Meal-provision in the student accommodation was in excess of energy-requirements  
43 and higher than the meals offered in chain-restaurants. Regulating or setting nutritional standards  
44 for all places that provide food is essential as current food provision may favour unwanted weight-  
45 gain and diet-related diseases.

## 46 **Background/Objectives**

47 Food eaten out of home has been suggested as a contributing factor to the obesity epidemic (Jeffery  
48 et al. 2006), and portion sizes have increased steadily over the past 20 years (Benson, 2009). Chain-  
49 restaurants have been particularly criticised both for the nutritional quality of the food they provide  
50 and the way they advertise their products, especially to children. Chain-restaurants, however,  
51 account only for approximately 25% of the total sales of food eaten outside home in the UK, while  
52 small independent catering facilities account for the majority (75%) (DEFRA,2011). More  
53 importantly, catering facilities in institutions such as universities, hospitals, and schools that usually  
54 provide more than one meal/day to service users are subject to minimal nutritional control posing a  
55 greater risk for the development of obesity and diet-related diseases. Only since April 2015,  
56 compulsory food standards were introduced in hospitals in England but still food quality varies  
57 greatly between hospitals and areas. Attention has been drawn to the nutritional content of chain-  
58 restaurant food, but no studies exist on nutritional provision in settings such as student  
59 accommodation, which provide food on a repeated daily basis. Catered accommodation takes the  
60 pressure off young adults from preparing and cooking their meals, while cost is also included in the  
61 accommodation price but this convenience comes with uncertain health implications. Food eaten  
62 outside home is often higher in calories and of poorer nutritionally quality (Prentice & Jebb, 2003)  
63 and people rarely can estimate the calorie content or the nutritional value of the food on offer  
64 (Chandon & Wansink, 2007). This is a particular public health concern because young adulthood;  
65 once a period of optimal health is now a period where rapid weight gain occurs (Nikolaou et  
66 al.2015, Crombie et al.2009) and poor eating habits can be established (Demory-Luce et al 2004).  
67 Students also can often be food insecure and relying solely on the food provided by the university  
68 due to the cost of studying and the cost of food (Hughes, 2012). Poor diet is not only a major  
69 contributing factor for chronic diseases, but can also affect the academic performance of students

70 (Florence et al. 2008). An awareness of the energy contents of meals may be valuable for  
71 interventions to prevent unwanted weight gain, diet-related diseases, and nudge caterers to review  
72 and modify the nutritional content of the food on offer

73 The present study analysed the nutritional content of the menu offered to university students living  
74 in catered accommodation and 1) compare it to current dietary recommendations and 2) with  
75 popular meals provided by the five largest chain restaurants in the UK.

## 76 **Subjects and Methods**

77 This study was exempt from IRB approval.

### 78 **Location of catering facilities included in the study**

79 1) The catered accommodation, located in an urban university, provides accommodation for  
80 approximately 120 students, mostly 1<sup>st</sup> year. Breakfast and evening meals are included in the  
81 accommodation price. The hall is located a 40-minute walk or 10-15 minute bus journey  
82 away the main University's campus. The closest retail grocery outlets were a 20 minute-  
83 walk away. Very limited cooking facilities are available on-site, so most students rely on  
84 meals provided in the hall.

85 2) The top five chain restaurants holding the largest share in the UK market were included in  
86 this study. Those were, according to the turnover in millions 1) McDonalds (£1,872m) 2) JD  
87 Wetherspoons (£ 1,038m) Greggs (£708m), 4) KFC (£614m) and 5) Costa coffee (£610m)  
88 (Statistica, 2013) Outlets of these five chain-restaurants were within the same postcode as  
89 the catered accommodation (Figure 1).

### 90 **Menus**

91 1) The menu comprised a five-week cycle, developed by the catering staff employed by the  
92 University, without any nutritional guidance. The main focus of caterers was on low food-

93 costs and wastage. All meals were prepared and cooked on site by in-house catering staff  
94 using standardised recipes. For meat and fish products, standard portions were purchased  
95 (110g per portion of meat and 170g per portion for fish) and other cooked food (eg rice,  
96 soup, potatoes) was served using standard utensils allowing the estimation of the calorie  
97 content of meals. Recipes, including ingredient lists, for all dishes served in the hall, were  
98 made available to the researcher for analysis by catering staff. Stock rooms were checked  
99 and all commercially prepared ingredients used for cooking or preparations of the meals  
100 were recorded.

101 2) All of the chain-restaurants had nutritional information of the products on sale available on-  
102 line and at the point of sale. Nutritional information available on-line included number of  
103 calories, amount of fat, saturated fat and salt. Three of these restaurants (McDonalds,  
104 Greggs, KFC) have made voluntarily pledges to reduce the calories consumed and started  
105 posting calorie information at the point of sale from 1 Jan 2013, under the English Health  
106 Department Responsibility Deal (DoH, 2014). The two remaining (JD Wetherspoons and  
107 Costa coffee) are partners in the Responsibility Deal since 2011.

108

### 109 **Meal combinations**

110 1) Evening meals comprised three courses. From a choice of three different main course  
111 dishes, students could only choose one, as well as a starter, dessert and a piece of fruit, or  
112 two pieces of fruit, or a piece of fruit and a pot of yogurt (125ml). The side dishes (rice,  
113 chips, and vegetables) were served using the same utensils to ensure portion-size  
114 consistency. In view of the numerous possible meal combinations, for this study it was  
115 assumed that each service user would choose the three-course meal. The meal-options for  
116 analysis were created by two formulae: meal-option 1 = starter + main course (from a choice

117 of 3) + side dishes + dessert; meal-option 2 = starter + main course (from a choice of 3) +  
118 side dishes + item of fruit.

119 2) Meal-combinations were created from the items listed using main course food items and a  
120 dessert, and a side dish. A side dish was used in order to be directly comparable with the  
121 meals provided at the hall.

122

### 123 **Data Analyses/Statistics**

124 All possible meal-combinations provided in the hall were compiled using an Access database  
125 (Microsoft Office Access, 2013). Nutritional composition of macronutrients and micronutrients of  
126 meal choices of the evening meal were determined using nutrient analysis software (WinDiets,  
127 Robert Gordon University, 2010). When commercial ingredients used in the preparation of meals  
128 were not listed, then that item was added to the database using manufacturer's nutrient values.

129 All possible meal-combinations provided in the five chain-restaurants were compiled in an Excel  
130 database using the nutritional information provided on the websites of the companies.

131 After data had been checked for normalcy, mean values and distributions of macronutrients and  
132 micronutrients were calculated and related to the UK Dietary Reference Values (DRVs) for  
133 macronutrients and Reference Nutrient Intake (RNIs) for micronutrients (DoH, 1991).

134 One-way analysis of variance (ANOVA) was used to test for differences between the catered  
135 accommodation menu and the chain-restaurants' menus for calories, macronutrients, and sodium,  
136 using SPSS 21 (SPSS, Chicago). Post hoc comparisons between pairs were also conducted. In order  
137 to keep the probability of type 1 error below 0.05, our main comparison pair was between the  
138 means of the catered accommodation menu and the means of all chain restaurants' menus.

### 139 **Results**

## 140 **Accommodation Meals**

141 A total of 210 combinations for evening meal choices were created from the five-week menu cycle,  
142 105 with a dessert (meal-option 1) and 105 replacing the dessert with two pieces of fruit (meal-  
143 option 2). Mean values for macronutrients and micronutrient contents are shown on **Table 1**. The  
144 mean (SD) nutritional contents of meal-option 1 were 1193(269)kcal, fat 52.0(22)g, saturated fat  
145 24.5(14.5)g, protein 42.4(28.5)g, carbohydrate 117.0(30)g, vitamin C 74(78)mg, iron 14(9)g,  
146 calcium 217(211)mg. Proportional energy contents were carbohydrate 39%, protein 14%, fat 39%,  
147 sat fat 18%. Mean nutritional contents of meal-option 2 were; 896(215)kcal, fat 29.0(17)g,  
148 saturated fat 9.9(8)g, protein 35.0(22)g, carbohydrate 125.0(24)g, vitamin C 90(75)mg, iron 6.3(2)g,  
149 calcium 206(189)mg. Proportional energy contents for meal-option 2 were carbohydrate 56%,  
150 protein 16%, fat 29%, sat fat 10%.

151

## 152 **Nutritional adequacy of meal-options.**

153 In general, almost all meal-options (86%-100%) exceeded the 30% recommendations for energy  
154 and for macronutrients. While most meal-options were adequate for most micronutrients, there  
155 were marked short-falls for some, especially iodine and calcium.

156

## 157 **Meal-option 1**

158 *Young men:* Expressed as % of Guideline Daily Amount (GDA) the mean values of macronutrients  
159 for this option were 48% of energy, with 55% of fat, 80% of saturated fat, 45% of protein and 98%  
160 of carbohydrate. Almost all meals exceeded the 30% recommendation for energy (n=105, 100%),  
161 for fat (n=103, 98%), for saturated fat (n=88, 84%), for protein (n=95, 90%), and for carbohydrate  
162 (n=105, 100%). The 30% recommendation was only met by 33% (n=35) of the meals for iodine,

163 13% (n=15) for calcium. A significant proportion of meals exceeded the 100% recommendation for  
164 fat (n=10, 9%) and for saturated fat (n=20, 18%).

165 *Young women:* Expressed as %GDA, this option provided means of 60% of energy, 74% of fat,  
166 120% of saturated fat, 56% of protein, and 130% of carbohydrate of the GDA. All meals exceeded  
167 the 30% recommendation for energy (n=105, 100%), for fat (n=105, 100%), for saturated fat  
168 (n=105, 100%), and for carbohydrate (n=105, 100%). The 30% recommendation was only met by  
169 10% (n=9) of the meals for iodine, and 5% (n=5) for calcium. A significant proportion of meals  
170 exceeded the 100% recommendation for fat (n=15, 14%) and for saturated fat (n=75, 71%).

171

## 172 **Meal-option 2**

173 *Young men:* Expressed as %GDA, this option provided means 36% of energy, 30% of fat, 33% of  
174 saturated fat, 37% of protein, and 104% carbohydrate. A high proportion of meals exceeded the  
175 30% recommendation for energy (n=90, 86%), for fat (n=88, 84%), for saturated fat (n=40, 38%),  
176 for protein (n=90, 86%), and for carbohydrate (n=105, 100%). The 30% recommendation was only  
177 met by 18% (n=20) of meals for iodine, 20% (n=18) for calcium. Only a small proportion of meals  
178 exceeded the 100% recommendation for saturated fat (n=5, 5%).

179 *Young women:* Expressed as %GDA, this option provided means of 45% of energy, 41% of fat,  
180 50% of saturated fat, 47% of protein, and 139% of carbohydrate. Most meals exceeded the 30%  
181 recommendation for energy (n=100, 95%), for fat (n=96, 91%), for saturated fat (n=55, 52%), for  
182 protein (n=103, 98%), and for carbohydrate (n=105, 100%). The 30% recommendation was only  
183 met by 18% (n=20) of meals for iodine, 20% (n=18) for calcium. Only a small proportion of meals  
184 exceeded the 100% recommendation for saturated fat (n=15, 14%).

185

186

### 187 **Chain-restaurants Menus**

188 In total 1,846 meal-combinations were created for the five chain-restaurants; 1) McDonalds=799, 2)  
189 JD Wetherspoons=496, 3) Greggs=180, 4) KFC=143, 5) Costa coffee=228. Mean values, standard  
190 deviation, and the range for calories, fat, saturated fat, protein, carbohydrate and sodium are shown  
191 in **Table 2** (JD Wetherspoons provides only the calorie content of meals and Greggs provides does  
192 not provide information on saturated fat).

193

### 194 **Comparison between independent catering facility and chain-restaurants menus**

195 Catered accommodation and chain restaurants menus were compared for calorie and macronutrient  
196 content. Meal-option 1 was significantly higher in calories than all the meals offered in all of the  
197 five-chain restaurants ( $p=0.015$ ), fat ( $p=0.02$ ) and saturated fat ( $p<0.001$ ). Meal option-2 was not  
198 different than the menus in the five chain restaurants.

199

### 200 **Discussion**

201 The current study aimed to assess the suitability of the nutritional composition of meals offered to  
202 young adults provided in a small independent catering facility within a UK University, compared  
203 with guidelines and with menus offered from chain-restaurants. The hall provided meals in excess  
204 of the 30% of requirements and so did the chain restaurants. Guidance from the former UK Food  
205 Standards Agency (FSA), now Department of Health, recommends that an evening meal should  
206 provide 30% of Guideline Daily Amount (GDA) of energy requirements (FSA, 2011), i.e. 600 kcal  
207 for women and 750 kcal for men. The meals offered to young adults in this hall greatly exceeded

208 this 30% energy recommendation, two-fold for energy and up to three-fold for certain  
209 macronutrients. For many micronutrients, most meal-options were ample, and indeed exceeded  
210 100% of daily requirements, but low contents were seen for some essential nutrients like iodine and  
211 calcium and vitamin D. Young adults often follow chaotic lifestyles and may commonly skip  
212 meals, or need extra energy to sustain sporting activities, in which case providing extra energy at  
213 evening meals might be desirable. However, since few young adults now engage in regular sporting  
214 activity and many are prone to rapid unwanted weight gain (Nikolaou et al.2015), routinely  
215 providing energy well above average requirements is unwise, at least without some warning. A  
216 youth choosing the highest calorie three-course option would exceed these recommended amounts  
217 for the evening meal by 1,630 kcal for women and 1,480 kcal for men. Making such high energy  
218 choices every day is improbable, but would lead to weight gains of about 6 kg per month, assuming  
219 that each kg weight gain requires a surplus intake of 7,000 kcal (Garrow, 1974). Assuming that  
220 young adults had average requirements and over time chose a range of meal-options which provided  
221 the average energy content (1193 kcal, about 400kcal above requirement), this excess from evening  
222 meals alone would still lead to weight gain would still be about 1.6 kg/ month.

223 When the meals provided in the accommodation were compared with the menus offered in chain  
224 restaurants, they proved to be 8%-35% higher in calorie content. Since, large chain-restaurants  
225 accounts for only a small proportion of the food eaten outside home, targeting only those, as in New  
226 York (Bernell, 2010), or under the English DoH 'Responsibility Deal' (DoH, 2014) to provide  
227 calorie information will have only a minor impact on the obesity crisis. A catered student  
228 accommodation is an interesting and important example of a smaller independent catering outlets,  
229 as it provides meals to young adults on a daily basis, which may have cumulative effects on health.  
230 It is likely that the patterns of nutrient contents will be similar in other commercial outlets.  
231 Consumers need better provision, in terms of menu and recipe design, at least to allow nutritionally

232 balanced meals to be chosen by those who want them, and to warn them when energy or nutrient  
233 contents are undesirable for long-term health.

234

235 Without nutritional information, it would be difficult for consumers to guess how the energy or  
236 nutrient contents relate to their needs or to recommended values for a meal. Even trained health  
237 professionals, such as dietitians, struggle to estimate nutritional contents of foods accurately  
238 (Backstard et al. 1997) or to identify when a menu is meeting the requirements for specific  
239 macronutrients. Commercial ready meals are currently nutritionally chaotic (Celnik et al.2012). It  
240 has been suggested that to improve health meals should be designed to provide 30% of  
241 macronutrients and micronutrients, as a 'default position'. This can easily be achieved by modifying  
242 recipe-ingredients, as shown by modifying traditional pizza recipes to match nutritional guidelines  
243 (Combet et al.2014).

244

245 There are several limitations in this study with the most important being the inability to measure the  
246 nutrient content of meals on offer with direct calorimetry. However, all meals are cooked on site  
247 with fresh ingredients and the principal researcher worked closely with the catering staff in order to  
248 get details of each recipe used. Also, quantities of ingredients used for preparing each recipe were  
249 confirmed by examining the ingredients orders and the stock room. Students residing in the hall  
250 were also observed during meal times hence the meal-options created and analysed for this study  
251 were realistic (Nikolaou et al. 2015).

252

253 Nutritional analyses of meal-options offered to young adults in an independent catering facility  
254 revealed excessive energy, carbohydrate, fat and saturated fat, and variable micronutrient contents  
255 compared to current recommendations. While desirable in certain cases, excess energy content is  
256 hard to identify and may promote unwanted weight gain and consumption of nutritionally

257 unbalanced diets. The nutritional profile of those menus was worse when compared with menus  
258 offered from chain-restaurants.

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316



318 **Table 1: Nutritional compositions of evening meal-options from the UK for macronutrients and**  
 319 **micronutrients, analysed in 2014**

Nutrient	Meal-option 1		Meal-option 2		DRV/RNI	DRV/RNI
	Mean	Range	Mean	Range	Females	Males
<b>Energy (kcal)</b>	1193	858-1774	896	594-1431	2000	2500
<b>Fat (g)</b>	52	17.6-105.5	29	5.6-78.5	70	95
<b>Saturated Fat (g)</b>	24.5	4.7-60.3	9.9	0.8-34.9	20	30
<b>Protein (g)</b>	42.4	15.8-129.3	35	15-119	75	94
<b>Carbohydrate (g)</b>	117	86-188	125	83-166	90	120
<b>Vitamin A (ug)</b>	1092	28-3390	1167	202-3255	600	700
<b>Thiamin (mg)</b>	24	0.12-433	24	0.2-433	0.8	1.1
<b>Riboflavin (mg)</b>	0.81	0.09-3.58	0.87	0.2-3.7	1.1	1.3
<b>Niacin (mg)</b>	25	2.4-105	25	2-105	14	18
<b>Vitamin B6 (mg)</b>	2.9	0.39-15	3.3	0.9-15.5	1.2	1.5
<b>Vitamin B12 (ug)</b>	1.5	0-5	1.2	0-5	1.5	1.5
<b>Folate (ug)</b>	105	30-330	124	54-359	200	200
<b>Vitamin C (mg)</b>	74	4.5-237	90	23.2-256	40	40
<b>Vitamin D (ug)</b>	4.5	0-13	5.3	1-13.5	200	200
<b>Calcium (mg)</b>	217	37-819	206	47-849	800	1000
<b>Magnesium (mg)</b>	102	38-228	180	31-114	300	300
<b>Sodium (mg)</b>	1295	141-2972	1281	49-2987	6000	6000
<b>Potassium (mg)</b>	1514	622-3419	604	234-1373	3.5	3.5
<b>Iron (g)</b>	14	2.5-59	6.3	3.8-12.2	14.8	8.7
<b>Zn (mg)</b>	19	0.6-149	16	2-150	7	9.5
<b>Mn (mg)</b>	3.4	0.3-28.5	3.1	0.7-29	1.4	1.4
<b>Se (ug)</b>	26	1.1-163.4	28	3-165	60	70
<b>I (ug)</b>	210	8-2678	145	0-2678	150	150

320 DRV=Dietary Reference Value, RNI=Reference Nutrient Intake

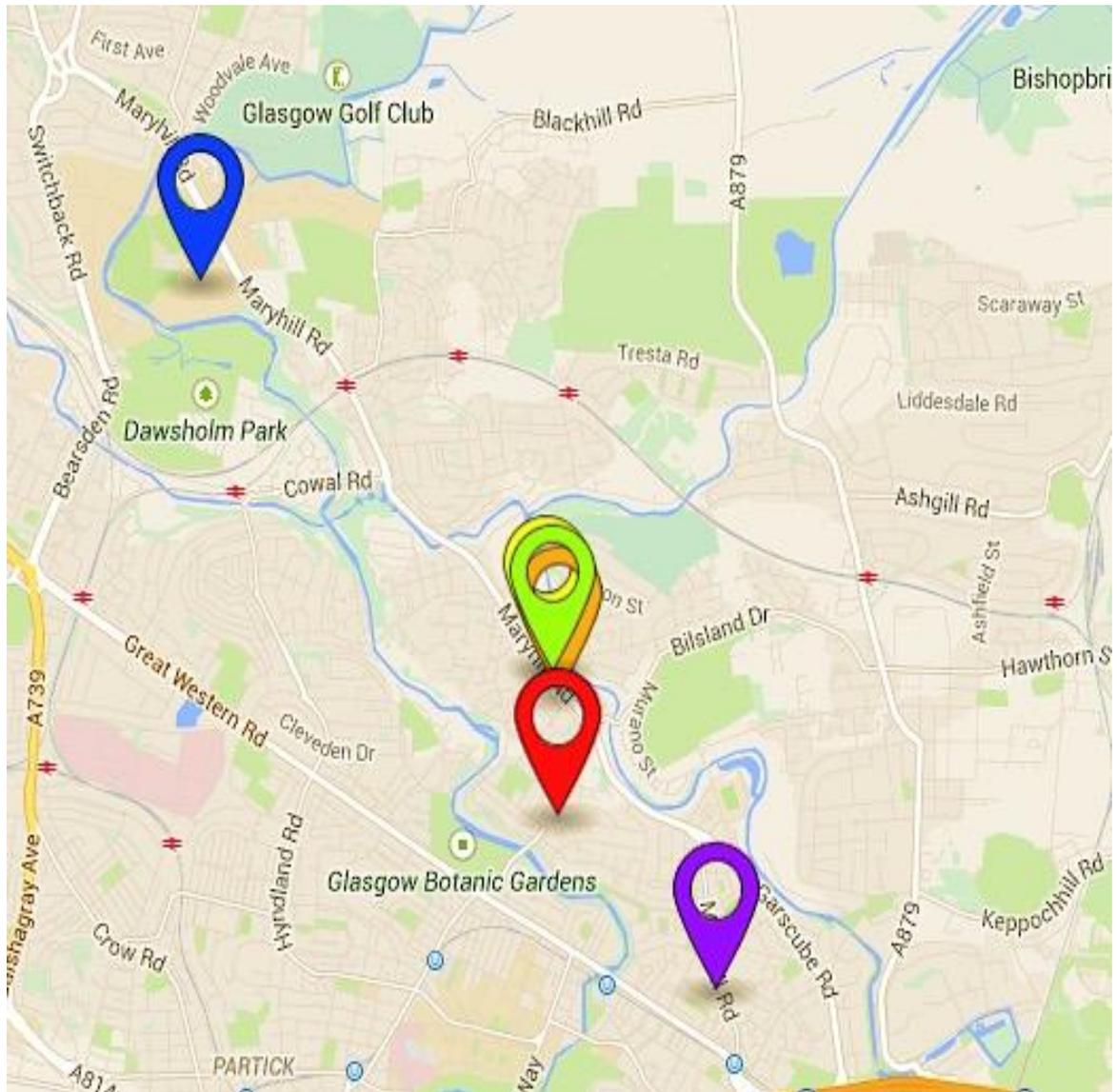
321 **Table 2:** Mean nutritional content of meals provided to the five biggest chain-restaurants in the UK for energy and key macronutrients, analysed in  
 322 2014  
 323

	Calories (kcal)		Fat (g)		Saturated Fat (g)		Carbohydrate (g)		Protein (g)		Sodium (mg)	
	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range
<b>McDonalds</b>	820 (289)	292-1240	26.4(16.9)	8.0-67.0	14.5 (9.0)	2.0-27.0	88.9 (29.9)	40.0-137	32.2(12.8)	11.0-49.0	945 (315)	433-1575
<b>JD Wetherspoons</b>	1,101 (267)	688-1,456	-	-	-	-	-	-	-	-	-	-
<b>Greggs</b>	885 (181)	630-1,170	45.2 (12.1)	27.0-59.0	-	-	107.3 (13.6)	88.5-116.5	26.7 (4.4)	22.0-31.5	1,221 (276)	788-1,536
<b>KFC</b>	773 (61)	430-1,100	39.8 (9.9)	19-54	11.7 (3.8)	5.5-47	80.9 (15.9)	48-122	24.5 (6.3)	17-37	1,604.3 (363.4)	880-2,300
<b>Costa Coffee</b>	855 (149)	648-1,132	35 (9.1)	18.5-49.0	12 (6.6)	3.0-24.5	105.7 (22.6)	79.8-142.8	26.6 (5.4)	19.9-36	947 (313)	501-1,410
<b>Meal 1</b>	1,193 (268)	858-1,774	52 (22)	17.6-105.5	24.5 (14.4)	4.7-60.3	117 (30)	86-188	42.4 (28.5)	15.8-129.3	1,295 (793)	141-2,972
<b>Meal 2</b>	896 (215)	594-1,431	29 (17)	5.6-78.5	9.9 (8)	0.8-34.9	125 (24)	83-166	35 (22)	15-119	1,281 (753)	49-2,987

324 **\*JD Wetherspoons only provided information on the calorie content of food items on the menu**

325 **\*Greggs did not provide the saturated fat content of food items on sal3**

**Figure 1:** Location of the catering outlets compared in this study in Scotland, UK



-  Costa coffee
-  Greggs
-  KFC
-  McDonalds
-  Student accommodation
-  Wetherspoons

**All outlets are within the same postcode, G20.**