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The temporal pattern of the contribution of fat to energy and of food groups to fat at various eating locations: implications for developing food-based dietary guidelines

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Abstract

Objectives: To examine the temporal pattern of the number of eating occasions that occurred at home, at work and outside the home, and to examine the contribution of fat to energy and the contribution of 26 food groups to fat at home and outside the home.
Design and setting: Food intake data were collected using a 7-day food diary from a random sample of 18–64-year-old adults from the Republic of Ireland ($n = 958$). Respondents recorded the day, time and location of every eating occasion.
Results: The number of eating occasions was constant across the days of the week for meals consumed at home, whereas the number of eating occasions increased at weekends for meals outside the home. The contribution of fat to energy approximated the 35% recommendation at home from Monday to Friday, but increased above this on Saturday and Sunday. The contribution of fat to energy outside the home was always above the recommendation. The food groups that contributed most to fat were similar at home and outside the home. These included butter and full-fat spreads, fresh meat, meat products, meat dishes, biscuits, cakes and pastries, whole milk, and chips and processed potatoes.
Conclusion: The contribution of fat to energy was above the recommendations when eating outside the home, regardless of day of the week. A number of food groups have been identified that contributed most to fat intake outside the home and these might be targeted in developing public health nutrition strategies to reduce fat intake.

Keywords
Food service sector
Fat
Energy
Ireland
Temporal patterns
Food groups

The need for the development of food-based dietary guidelines (FBDG) has been highlighted in recent years, in order to make nutritional goals more meaningful for the general population[1]. FBDG need to be culturally acceptable, practical and comprehensible for the target group. According to Kearney *et al.*[2], to ensure that FBDG are culturally acceptable it is important to consider where and when foods are eaten. This suggests a need to examine the temporal pattern of consumption across various locations.

An exhaustive literature search failed to find published papers examining nutrient intakes across day or hour in different locations. However, some papers[3–13] were available that examined intakes across the days of the week without separating the data by location. These papers give conflicting results, with only some showing a significant effect of day of the week.

The North/South Ireland Food Consumption Survey (NSIFCS) established a detailed database of habitual food and drink consumption, including the day, time and eating location, for every item consumed[14]. This allows for the comparison of intakes across day or hour in different locations, which is the first such work to be carried out. The present paper aims to examine and compare the temporal pattern of the contribution of fat to energy and the contribution of 26 food groups to fat in the home and outside the home, which could be used in the development of future public health nutrition strategies.

Methods

Full details of the methods and sampling procedures used in the NSIFCS have been given by Kiely *et al.*[15] and Harrington *et al.*[14]. In brief, the NSIFCS was carried out in Ireland between 1997 and 1999 on a random representative sample of Irish adults. In total, 1379 adults aged 18 to 64 years, from both the Republic of Ireland and Northern Ireland, participated in the survey[15]. Data were collected on food intakes and a series of questionnaires was used to gather sociodemographic data[14]. In this study, only data from the Republic of Ireland were used ($n = 958$).

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Food intakes

Data on food and beverage intakes were collected using a 7-day food diary. Respondents recorded the day, time, eating location, meal type, quantity of food, cooking methods and recipes for each eating occasion. The foods were coded using *McCance & Widdowson's The Composition of Foods*[16] and published supplements[17–25]. Nutrient intakes were calculated using WISP© (Weighed Intake Software Package; Tinuviel Software, Warrington, UK)[14]. The intake of fat as a percentage of energy was calculated excluding alcoholic and associated non-alcoholic beverages. Associated non-alcoholic beverages refer to non-alcoholic beverages consumed with alcoholic beverages, for example, in a gin and tonic. The contribution of fat to energy was compared with current recommendations[26].

Location of eating occasions

Eight location codes were used for the eating locations when coding the food diaries for data entry. These were based on where the food was prepared rather than where the food was eaten. The eight locations were: (1) at home; (2) at work; (3) at a friend's home; (4) at a relative's home, family home or meals on wheels; (5) at a restaurant, hotel or pub; (6) at a coffee shop, shop, deli or sandwich bar; (7) at a takeaway or cinema; and (8) at social functions (parties, receptions). These eight codes were aggregated to form three groups in the same manner as in previous research in this group[27]. The abbreviated terms 'home', 'work' and 'outside the home' are used to describe the three new locations. 'Home' comprises food consumed at home, at a friend's home, at a relative's home, at a family home or from meals on wheels. 'Work' refers to food prepared and eaten at work only, for example food purchased in a work canteen. 'Outside the home' consists of food consumed in a restaurant, hotel, pub, coffee shop, shop, deli, sandwich bar, takeaway and cinema, and at social functions (parties, receptions). Given that the food service sector (FSS) is the primary focus of the present study, most of the analysis focused on foods consumed at home and outside the home.

Number of eating occasions

An eating occasion was defined as any meal, snack or beverage with greater than 0 kJ. The mean number of eating occasions at each location was calculated for each day and for each hour for the consumers only at each location for the day or hour. A variable was created for hour that defined each hour by the 30 minutes before and the 29 minutes after the hour. Therefore, hour 10 refers to the time from 09.30 to 10.29 hours.

Food groups

The mean intake (g) and the percentage of consumers were calculated for each of 26 food groups consumed at home and outside the home for day and for hour. The percentage contributions of these 26 food groups to protein, fat and carbohydrate were examined by day for food consumed at home and outside the home. The data present the contribution of the food groups to fat only. Additional analysis of the food groups was also conducted, which included examining the intakes of the 26 food groups per MJ of food energy (excluding ethanol) at home and outside the home by day. The daily intake of each food group as a percentage of the weekly total at home and outside the home was also calculated to control for small numbers of consumers. The intakes per MJ of food energy (excluding ethanol) were examined to control for the differences in energy intakes between men and women and at the different locations.

Statistical analysis

Statistical analysis was carried out using SPSS® Version 10.0 for Windows™ (SPSS Inc., Chicago, IL, USA). Mean ± standard deviation was calculated for the number of eating occasions, nutrient intakes and food group intakes by sex, eating location and day or hour. The method of calculating the latter was as follows. In calculating the mean by day, the sum of the variable per day was calculated per person for each location. The overall mean of these values was then examined. It was decided to calculate the sum of the variable per day for each respondent first, as the overall mean would then represent the average of the total number of eating occasions or the average of the total amount of a food group consumed on any given day. In contrast, when calculating the mean by hour, the mean of the variable per hour was calculated for each respondent for each location. The overall mean of these values was then calculated. The mean per hour was calculated per person first so that the overall mean would represent the average intake or average number of eating occasions at each hour and not the weekly intake or the weekly number of eating occasions at each hour.

A three-way analysis of variance (ANOVA) was conducted to examine the individual and interaction effects of sex, eating location and day of the week on the number of eating occasions and the percentage contribution of fat to energy. When significant effects existed, one-way ANOVA was used to examine the data for significant differences between groups. Homogeneity of variance was examined using Levene's test. In datasets with equality of variance, the Scheffe *post hoc* test was used to identify where these differences were. The Tamhane *post hoc* test was used where there was inequality of variance. Values of $P < 0.05$ were considered statistically significant.

Results

Table 1 shows the mean number of eating occasions and the percentage of consumers at each location by day and

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Table 1 Mean number of eating occasions and percentage of consumers by location and day or hour

	Males												Females											
	Home				Work				Out				Home				Work				Out			
	n	Mean	SD	%	*n*	Mean	SD	%	*n*	Mean	SD	%	*n*	Mean	SD	%	*n*	Mean	SD	%	*n*	Mean	SD	%
By day																								
Monday	470	3.4	1.4	98.9	216	2.0	1.2	66.1	139	1.8	1.4	33.8	480	3.9	1.6	99.4	178	1.9	1.0	64.7	128	1.3	0.6	31.2
Tuesday	473	3.3	1.4	99.6	226	2.0	1.2	69.1	156	1.7	1.0	38.0	479	3.9	1.7	99.2	180	2.0	1.1	65.5	113	1.7	1.2	27.6
Wednesday	467	3.4	1.4	98.3	223	1.9	1.1	68.2	168	1.9	1.5	40.9	478	3.9	1.7	99.0	185	2.0	1.1	67.3	144	1.6	1.2	35.1
Thursday	465	3.4	1.4	97.9	211	2.0	1.2	64.5	167	2.2	1.8	40.6	479	3.8	1.6	99.2	185	1.9	1.1	67.3	173	1.6	1.1	42.2
Friday	464	3.3	1.5	97.7	216	1.9	1.1	66.1	230	2.3	2.1	56.0	474	3.8	1.7	98.1	174	2.1	1.1	63.3	177	2.0	1.7	43.2
Saturday	462	3.6	1.6	97.3	73	1.9	1.3	22.3	271	2.7	2.6	65.9	478	3.8	1.6	99.0	64	2.1	1.4	23.3	233	2.0	1.7	56.8
Sunday	468	3.4	1.4	98.5	34	2.0	1.1	10.4	219	2.4	2.2	53.3	481	3.8	1.5	99.6	43	2.1	1.2	15.6	178	1.6	1.0	43.4
By hour																								
1	71	1.5	0.8	14.9	7	1.7	0.8	2.1	53	1.9	1.7	12.9	36	1.3	0.7	7.5	7	1.6	0.8	2.5	36	1.5	0.9	8.8
2	26	1.5	0.9	5.5	8	3.3	1.9	2.4	33	2.1	2.2	8.0	20	1.4	0.7	4.1	5	1.4	0.5	1.8	22	1.3	0.6	5.4
3	10	1.3	0.7	2.1	9	1.3	0.5	2.8	23	1.6	1.9	5.6	17	1.1	0.2	3.5	3	1.7	1.2	1.1	5	1.0	0.0	1.2
4	13	1.2	0.6	2.7	7	2.3	1.4	2.1	5	1.4	0.5	1.2	5	2.0	2.2	1.0	0	–	–	0.0	0	–	–	0.0
5	15	1.9	1.2	3.2	4	2.8	1.7	1.2	1	1.0	–	0.2	9	1.6	1.3	1.9	5	1.6	0.9	1.8	1	1.0	–	0.2
6	42	2.4	1.9	8.8	7	1.7	1.1	2.1	1	1.0	–	0.2	20	1.7	1.3	4.1	5	1.0	0.0	1.8	0	–	–	0.0
7	131	2.7	1.7	27.6	14	1.6	1.3	4.3	2	1.5	0.7	0.5	99	2.8	1.7	20.5	8	1.8	1.0	2.9	1	1.0	–	0.2
8	281	3.2	1.8	59.2	31	2.0	1.3	9.5	10	1.6	1.0	2.4	275	3.3	1.8	56.9	15	1.7	1.1	5.5	3	1.0	0.0	0.7
9	285	2.7	1.9	60.0	54	2.0	1.6	16.5	16	1.4	0.8	3.9	326	2.8	1.7	67.5	39	2.0	1.3	14.2	11	1.1	0.3	2.7
10	283	2.2	1.6	59.6	136	2.5	1.7	41.6	39	1.2	0.6	9.5	324	2.2	1.4	67.1	96	2.4	1.5	34.9	22	1.1	0.3	5.4
11	270	1.9	1.3	56.8	160	2.4	1.4	48.9	56	1.4	0.8	13.6	313	2.0	1.3	64.8	159	2.7	1.5	57.8	51	1.3	0.7	12.4
12	198	1.6	1.0	41.7	79	2.2	1.5	24.2	59	1.2	0.7	14.4	253	1.8	1.1	52.4	79	1.7	1.0	28.7	70	1.2	0.6	17.1
13	347	2.7	1.7	73.1	157	2.3	1.4	48.0	136	1.8	1.1	33.1	389	2.7	1.6	80.5	138	2.3	1.4	50.2	135	1.5	0.9	32.9
14	332	2.2	1.4	69.9	96	1.8	1.2	29.4	143	1.5	1.0	34.8	376	2.4	1.5	77.8	97	2.0	1.3	35.3	126	1.3	0.6	30.7
15	199	1.5	0.9	41.9	68	1.8	1.2	20.8	74	1.3	0.8	18.0	264	1.9	1.0	54.7	81	1.7	1.1	29.5	83	1.2	0.4	20.2
16	205	1.7	1.1	43.2	107	1.7	0.8	32.7	97	1.2	0.6	23.6	299	2.0	1.2	61.9	86	1.8	1.2	31.3	95	1.2	0.5	23.2
17	223	1.8	1.1	46.9	69	1.6	1.1	21.1	93	1.4	0.7	22.6	272	2.1	1.3	56.3	48	1.5	0.7	17.5	76	1.2	0.4	18.5
18	367	2.9	1.7	77.3	48	1.4	0.9	14.7	108	1.5	0.9	26.3	405	3.0	1.7	83.9	33	1.7	1.0	12.0	83	1.2	0.5	20.2
19	381	2.8	1.6	80.2	23	1.6	1.1	7.0	112	1.4	0.8	27.3	413	2.7	1.4	85.5	32	1.4	0.7	11.6	78	1.2	0.5	19.0
20	297	1.9	1.2	62.5	17	1.4	0.9	5.2	105	1.6	1.0	25.5	323	2.1	1.2	66.9	12	1.3	0.6	4.4	75	1.3	0.5	18.3
21	274	2.0	1.3	57.7	21	1.4	0.7	6.4	159	1.7	1.2	38.7	337	2.2	1.4	69.8	13	1.4	0.8	4.7	125	1.4	0.6	30.5
22	309	2.2	1.3	65.1	16	1.6	0.9	4.9	202	2.0	1.6	49.1	352	2.3	1.3	72.9	8	1.6	0.7	2.9	151	1.5	0.8	36.8
23	238	2.1	1.2	50.1	9	1.1	0.3	2.8	157	2.3	2.2	38.2	259	2.0	1.3	53.6	13	1.4	0.5	4.7	128	1.7	1.0	31.2
24	149	1.8	1.1	31.4	9	1.8	1.1	2.8	115	2.1	1.8	28.0	113	1.5	1.0	23.4	11	1.6	0.9	4.0	70	1.6	0.9	17.1

SD – standard deviation.

by hour for men and women separately. For foods consumed at home, the percentage of consumers and the number of eating occasions were constant across the days of the week. Three distinct mealtime peaks were evident for both, at hours 7–9, 13–14 and 18–20. For food consumed at work, the number of eating occasions was also constant across the days; however, the percentage of consumers fell at weekends. Across the hours of the day, two peaks were evident for the number of eating occasions and percentage of consumers at hours 10–11 and 13 at work. The number of eating occasions and the percentage of consumers increased at the weekend outside the home. Sex and location demonstrated a significant interaction effect ($P < 0.001$), which reflects the different patterns in the number of eating occasions in men and women across the locations. The three-way ANOVA also showed a significant interaction effect for location and day ($P < 0.001$). This reflects the changing pattern in the number of eating occasions across the week, in that the number of eating occasions decreased at work towards the weekend whereas, outside the home, the number of eating occasions increased.

Table 2 presents the mean percentage contribution of fat to food energy excluding the alcoholic and associated non-alcoholic beverages by day and hour. The contribution remained close to or slightly above the recommendation of 35% food energy from fat[26] at home for men and women from Monday to Friday, but increased above this on Saturday and Sunday. Outside the home, the contribution of fat to food energy was always above the recommendation. Location and day had significant main effects ($P < 0.001$); however, the interactive effects did not reach statistical significance. A one-way ANOVA showed that for men, the contribution of fat at home was significantly greater ($P < 0.01$) on Saturday than on Monday to Friday; for women, the contribution of fat at home was significantly greater ($P < 0.05$) on Saturday than on Tuesday to Thursday. When eating out, no significant differences existed between the days of the week for either men or women. Across the hours of the day, the contribution of fat was above the recommendation at lunch and evening times. Outside the home, the contribution was above the recommendations for almost all hours.

Table 2 Mean percentage contribution of fat to food energy per day and hour for men and women by eating location, excluding alcohol and associated non-alcoholic beverages

	Males						Females					
	Home			Out			Home			Out		
	n	Mean	SD	*n*	Mean	SD	*n*	Mean	SD	*n*	Mean	SD
By day												
Monday	469	35.3	9.1	105	44.0	14.0	480	35.5	10.2	113	41.7	14.0
Tuesday	473	34.7	10.1	121	45.3	11.9	479	34.7	10.3	104	42.5	14.1
Wednesday	466	35.4	9.1	127	42.6	13.8	478	35.1	9.9	123	43.8	14.2
Thursday	464	35.1	9.0	120	43.4	14.1	478	35.2	10.5	154	43.1	13.8
Friday	463	35.7	10.3	184	43.7	12.5	472	35.9	10.3	158	45.6	12.1
Saturday	462	38.2	10.6	189	43.4	12.6	477	37.5	10.2	193	45.8	11.4
Sunday	468	36.6	10.1	159	44.6	12.7	481	36.4	9.9	147	46.0	15.1
By hour												
1	65	36.2	16.0	17	49.6	8.8	28	38.8	15.3	13	47.9	16.8
2	23	32.3	17.5	8	48.4	11.2	18	39.7	15.4	11	35.9	16.9
3	8	30.7	20.2	13	50.7	10.3	13	40.8	11.5	3	35.6	20.4
4	10	36.3	16.0	3	50.0	5.2	5	32.9	23.7	0	0.0	–
5	13	31.2	14.3	1	53.2	–	8	28.2	18.1	0	0.0	–
6	41	26.0	13.7	1	19.7	–	20	27.8	14.0	0	0.0	–
7	131	26.9	11.0	2	35.5	8.3	98	28.3	14.4	1	21.3	–
8	279	28.4	12.3	8	43.9	9.6	275	27.2	12.8	3	48.6	7.9
9	284	29.3	13.3	15	46.9	13.7	325	28.4	13.1	10	49.3	12.5
10	281	32.6	14.5	36	45.8	14.8	324	30.3	13.8	22	48.8	12.2
11	268	32.9	14.4	52	43.6	16.5	309	31.6	14.3	48	37.5	17.7
12	196	34.7	14.0	47	40.8	15.8	251	33.0	14.7	70	44.0	13.7
13	347	37.6	11.9	126	43.9	9.6	389	36.4	12.9	133	42.5	12.9
14	332	35.5	11.4	131	40.8	12.6	376	37.2	12.5	124	42.5	13.6
15	198	35.5	14.5	55	43.4	16.3	261	35.6	14.5	81	42.9	11.0
16	202	34.2	15.1	68	41.3	16.2	296	34.7	14.9	92	43.6	13.1
17	221	36.7	14.7	67	42.0	15.5	271	35.7	14.0	71	42.9	20.4
18	366	37.4	11.2	70	41.6	15.3	402	37.3	10.7	70	43.0	14.2
19	380	37.8	9.6	76	42.8	12.9	410	38.9	11.8	66	46.0	16.0
20	291	37.6	13.1	53	46.5	13.0	322	37.7	13.8	55	43.5	12.8
21	262	37.9	13.8	83	46.1	13.8	326	36.7	14.7	74	47.1	12.8
22	291	36.6	13.3	68	44.6	15.5	339	37.6	15.4	64	43.4	19.1
23	218	36.4	14.4	37	40.9	18.8	232	34.3	15.9	38	42.5	19.0
24	132	36.3	14.3	41	46.2	7.8	101	35.8	16.2	19	47.3	13.0

SD – standard deviation.

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Tables 3 and 4 present the mean percentage contribution of the 26 food groups to fat intake at home and outside the home for men and women, respectively. Details of the composition of the 26 food groups are presented in the Appendix. The tables present the data for each individual day of the week and the overall mean daily contribution of the food groups to fat. The food groups are ranked based on the mean daily column. Among men at home, butter and full-fat spreads, fresh meat, whole milk, meat products and biscuits, cakes and pastries were the five food groups which contributed most to fat. However, butter and full-fat spreads, fresh meat, biscuits, cakes and pastries, whole milk and meat dishes contributed most in women. Outside the home, the highest contribution to fat came from chips and processed potatoes, meat products, fresh meat, butter and full-fat spreads and creams, ice creams and desserts in men. In women, the same food groups contributed most to fat with the exception that biscuits, cakes and pastries replaced fresh meat.

Many differences were also evident across the days of the week (Tables 3 and 4). For men and women at home, the contributions of fresh meat, meat products, vegetables

Table 3 Mean percentage contribution of 26 food groups to fat intake for men at home and outside the home

	Mean daily	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Home	$n = 475$	$n = 469$	$n = 473$	$n = 466$	$n = 464$	$n = 463$	$n = 462$	$n = 467$
Butter & full-fat spreads	15.2	16.2	15.1	16.6	17.4	16.6	15.5	14.7
Fresh meat	13.5	12.6	13.5	11.4	11.8	9.1	12.9	18.8
Whole milk	9.4	11.6	12.5	11.3	11.6	12.1	9.8	9.8
Meat products	7.1	5.7	4.7	5.9	5.6	5.7	8.6	6.8
Biscuits, cakes & pastries	5.9	6.1	6.3	6.1	6.8	5.5	4.8	5.8
Chips & processed potatoes	5.5	4.2	3.9	4.5	4.7	5.9	5.1	4.6
Meat dishes	5.4	5.3	7.6	6.2	4.5	4.6	4.3	3.1
Bread	4.7	4.8	4.7	5.0	5.3	5.8	5.3	4.8
Cheese	4.1	3.9	3.5	3.8	4.1	3.8	4.4	3.3
Vegetables & vegetable dishes	3.3	3.0	3.1	2.8	3.2	3.1	3.6	2.7
Eggs & egg dishes	3.2	3.0	2.7	2.5	1.9	3.3	4.1	3.0
Creams, ice creams & desserts	3.0	2.8	2.9	2.6	1.6	2.0	2.0	5.1
Fish & fish dishes	2.9	2.7	2.2	3.0	3.7	4.9	2.2	1.1
Low-fat spreads	2.9	3.1	3.2	3.1	2.9	3.8	3.5	2.9
Soups, sauces & miscellaneous foods	2.2	1.7	2.3	2.3	2.4	2.1	1.8	2.1
Savouries	2.1	2.6	1.5	1.6	1.7	1.6	2.4	1.5
Sugars & confectionery	2.0	2.2	1.5	2.3	2.0	2.1	1.8	2.2
Potatoes: boiled, mashed, baked	1.9	1.9	1.9	2.1	2.2	1.6	1.3	2.2
Savoury snacks	1.4	1.4	1.0	1.1	1.5	1.2	1.4	1.3
Breakfast cereals	1.4	2.0	1.9	2.0	2.0	2.0	1.2	1.1
Low-fat milk	1.2	1.5	1.8	1.9	1.5	1.5	1.9	1.5
Fruit, juices & nuts	0.8	0.6	1.0	0.9	0.7	1.0	1.2	1.1
Yoghurts	0.4	0.4	0.6	0.5	0.5	0.3	0.5	0.2
Rice & pasta	0.3	0.4	0.6	0.3	0.3	0.4	0.3	0.2
Beverages	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0
Alcoholic beverages	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Outside the home	$n = 370$	$n = 103$	$n = 120$	$n = 125$	$n = 119$	$n = 183$	$n = 187$	$n = 158$
Chips & processed potatoes	17.4	14.6	10.7	12.7	15.4	15.4	16.2	18.6
Meat products	11.3	13.9	10.3	11.5	9.9	12.9	12.8	10.8
Fresh meat	9.4	9.6	10.5	10.7	10.4	9.2	10.4	12.2
Butter & full-fat spreads	7.9	7.8	10.3	9.4	8.9	8.0	6.7	7.0
Creams, ice creams & desserts	6.5	3.2	6.7	3.4	5.3	3.1	7.0	7.4
Meat dishes	5.4	1.6	2.6	2.4	2.4	5.5	7.6	4.1
Sugars & confectionery	5.2	7.4	7.1	6.9	4.8	4.9	6.0	5.1
Soups, sauces & miscellaneous foods	4.8	6.4	6.2	5.2	5.4	3.5	4.1	4.5
Vegetables & vegetable dishes	3.7	5.2	3.2	4.4	4.6	3.7	2.6	2.7
Whole milk	3.7	6.3	8.2	6.8	5.0	5.4	3.4	3.3
Biscuits, cakes & pastries	3.5	2.3	3.7	4.3	3.7	2.3	3.3	2.2
Fish & fish dishes	3.4	3.6	1.1	3.0	4.9	4.0	2.1	1.2
Savouries	3.3	1.5	1.1	3.0	2.5	2.8	4.0	4.0
Savoury snacks	3.1	2.4	3.7	2.5	2.9	4.7	2.9	5.8
Bread	2.9	2.7	5.4	3.5	4.1	3.4	2.1	2.4
Cheese	2.2	2.3	2.4	3.4	1.9	3.1	1.5	1.0
Eggs & egg dishes	2.0	2.0	3.3	1.8	2.2	1.9	1.5	2.1
Fruit, juices & nuts	2.0	2.4	1.2	3.4	2.7	3.0	4.0	3.0
Potatoes: boiled, mashed, baked	1.6	4.5	1.7	1.1	2.1	2.6	0.7	1.8
Low-fat milk	0.2	0.0	0.1	0.1	0.7	0.1	0.3	0.2
Rice & pasta	0.2	0.0	0.2	0.1	0.1	0.2	0.3	0.2
Low-fat spreads	0.1	0.2	0.1	0.0	0.0	0.1	0.4	0.2
Alcoholic beverages	0.1	0.0	0.0	0.3	0.0	0.0	0.0	0.1
Beverages	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Breakfast cereals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yoghurts	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Table 4 Mean percentage contribution of 26 food groups to fat intake for women at home and outside the home

	Mean daily	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Home	$n = 483$	$n = 480$	$n = 478$	$n = 478$	$n = 478$	$n = 472$	$n = 477$	$n = 481$
Butter & full-fat spreads	12.3	12.3	12.5	12.8	13.5	13.4	12.8	12.3
Fresh meat	10.5	12.9	9.8	8.8	9.2	5.9	10.0	14.6
Biscuits, cakes & pastries	7.5	7.3	7.4	8.6	7.2	7.1	8.0	6.4
Whole milk	7.5	9.1	9.4	8.8	8.6	9.6	8.3	7.7
Meat dishes	5.8	5.4	7.9	6.6	6.7	4.8	5.3	2.1
Meat products	5.8	4.6	3.9	5.3	4.7	4.5	7.0	5.5
Bread	5.2	4.9	6.0	5.1	5.7	5.8	6.2	4.8
Chips & processed potatoes	5.1	4.1	3.3	3.9	4.5	5.4	3.5	5.9
Vegetables & vegetable dishes	4.9	4.5	4.5	4.2	4.3	4.7	4.3	4.9
Cheese	4.4	4.5	3.7	3.9	3.7	5.2	4.2	3.2
Creams, ice creams & desserts	3.7	2.4	2.8	2.6	2.5	2.3	2.8	7.2
Low-fat spreads	3.3	3.8	3.8	3.5	4.1	3.7	3.9	3.3
Sugars & confectionery	3.3	3.4	3.1	3.3	3.8	2.6	4.0	3.6
Fish & fish dishes	3.2	2.0	3.4	4.1	2.2	5.6	1.6	1.3
Soups, sauces & miscellaneous foods	3.2	2.9	3.5	2.9	3.0	2.8	2.8	3.3
Eggs & egg dishes	2.8	3.0	2.4	2.3	2.5	2.7	3.5	2.2
Savouries	2.7	2.4	2.1	2.4	2.3	3.4	1.6	2.6
Low-fat milk	2.0	2.7	2.8	2.7	2.5	2.9	2.8	2.6
Breakfast cereals	1.8	2.5	2.3	2.4	2.4	2.1	2.3	1.5
Savoury snacks	1.7	1.3	1.5	1.6	1.9	2.3	2.0	1.2
Potatoes: boiled, mashed, baked	1.3	1.6	1.5	1.5	1.2	0.8	0.6	1.8
Fruit, juices & nuts	1.0	1.1	1.2	1.3	1.9	1.0	1.1	1.0
Yoghurts	0.5	0.7	0.5	0.6	0.7	0.7	0.5	0.3
Rice & pasta	0.3	0.4	0.5	0.4	0.6	0.4	0.3	0.2
Alcoholic beverages	0.1	0.0	0.0	0.0	0.0	0.0	0.3	0.2
Beverages	0.1	0.1	0.0	0.0	0.1	0.0	0.1	0.1
Outside the home	$n = 389$	$n = 111$	$n = 103$	$n = 121$	$n = 152$	$n = 158$	$n = 193$	$n = 145$
Chips & processed potatoes	12.3	8.4	10.9	9.8	11.3	10.5	12.1	15.0
Butter & full-fat spreads	7.2	11.5	7.6	8.6	9.0	6.8	7.2	4.3
Biscuits, cakes & pastries	7.1	8.0	8.5	3.3	7.0	6.3	6.6	6.7
Meat products	7.0	6.8	6.9	7.3	5.3	6.1	9.7	4.2
Creams, ice creams & desserts	6.8	3.4	4.2	5.7	5.3	7.4	6.9	7.8
Soups, sauces & miscellaneous foods	6.3	4.1	8.3	7.3	6.6	6.8	5.3	4.3
Whole milk	5.5	12.5	8.9	8.0	9.1	9.2	5.3	7.3
Fresh meat	5.5	4.8	4.3	5.4	4.3	6.1	5.1	5.0
Meat dishes	5.5	4.5	2.9	5.7	5.7	4.6	3.4	3.8
Sugars & confectionery	5.5	7.7	8.5	5.7	4.3	4.4	4.9	8.9
Savoury snacks	5.0	2.9	4.6	4.6	3.5	4.3	5.0	9.5
Vegetables & vegetable dishes	4.6	3.8	3.9	3.6	4.9	4.8	6.0	3.6
Savouries	4.1	3.5	2.9	4.4	3.9	4.0	3.9	2.7
Bread	4.0	6.1	3.2	6.1	7.5	3.8	5.2	1.8
Fish & fish dishes	3.5	3.0	4.1	3.3	2.4	4.4	2.1	2.1
Cheese	2.8	2.8	3.3	3.7	2.7	2.7	3.2	2.6
Fruit, juices & nuts	2.2	1.3	2.8	2.1	3.0	2.9	1.3	5.8
Eggs & egg dishes	2.2	2.4	2.5	1.8	2.6	1.7	1.7	1.7
Potatoes: boiled, mashed, baked	1.2	0.7	0.6	0.7	0.7	1.0	2.0	1.2
Alcoholic beverages	0.6	0.0	0.0	1.0	0.0	0.1	1.0	0.3
Low-fat milk	0.3	0.2	0.5	1.2	0.2	0.3	1.3	0.9
Rice & pasta	0.3	0.4	0.3	0.3	0.3	0.2	0.1	0.1
Low-fat spreads	0.3	0.8	0.3	0.1	0.0	0.3	0.6	0.3
Beverages	0.1	0.1	0.0	0.1	0.1	1.3	0.2	0.0
Yoghurts	0.1	0.2	0.1	0.2	0.2	0.1	0.0	0.0
Breakfast cereals	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0

and vegetable dishes and creams, ice creams and desserts were highest on Saturday or Sunday. Outside the home, chips and processed potatoes, creams, ice creams and desserts, savoury snacks and fruits, juices and nuts contributed most to fat at the weekend (Saturday or Sunday).

Discussion

According to Kearney *et al.*[2], consideration of the cultural acceptability of FBDG requires analysis of where and when foods are eaten, and thus temporal analysis and the examination of foods consumed outside the home were identified as areas of importance in the formation of FBDG. The present study set out to examine the temporal distribution of food and nutrient intakes in the FSS and therefore examined these intakes over days of the week and hours of the day. This makes this study quite unique as none of the available literature has examined the temporal patterns of intakes in the FSS. However, some papers have examined nutrient intakes across the days of the week and these can be used to make broad comparisons.

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In a previous study of the FSS[27], the need to consider the contribution of fat to food energy excluding alcoholic beverages was highlighted. Initially, this method was also used in the present study. The results showed that, outside the home, the percentage contribution of fat to energy was always above the recommendation (38–42%) for both men and women on all days of the week. However, on Saturday for men, the percentage contribution dropped to 38%, which was the lowest point in the week, giving the impression that on Saturdays, when eating outside the home, men had diets with the lowest contribution from fat. It appeared that this was confounded by the use of soft drinks as mixers, which would lower the contribution from fat. Therefore, it was decided to analyse this further by removing the associated non-alcoholic beverages, for example, the tonic in a gin and tonic. In the case of a gin and tonic, the gin represents 68% of the energy and the tonic 32%. Following this adjustment, the contribution from fat intake across the week increased to 42–45% in men and 42–46% in women and the decrease in the contribution among men on Saturdays was no longer evident. This again highlights the potential confounding effect not just of ethanol, but of all of the energy of alcoholic beverages and associated mixers.

Previous research in this group has shown that the percentage contribution from fat to energy in the FSS was higher than that in the home[27]. The present study involved considerable food group analyses in an attempt to identify the potential foods consumed outside the home that led to the higher contribution from fat. A number of confounding methodological issues was identified in this regard. The actual intake (g) of each of 26 food groups was examined for men and women separately across the days of the week at each location. This analysis was generally unhelpful since people consume a greater amount of most food groups at home and so have higher intakes. Attempts to overcome this by adjusting for energy intake did not improve the analysis. The energy intake outside the home is approximately a quarter (28% for men, 22% for women) that inside the home and thus adjustment for energy distorts the relative intakes at home and outside the home.

The third method of analysis was to look at the contribution of the 26 food groups to fat. Few significant differences existed between home and outside the home. It was decided to rank the foods based on their contribution to fat, so that those that contributed most could be identified as target foods in developing public health nutrition goals for fat reduction (Tables 3 and 4). On that basis, the key foods to be targeted to lower fat intake in the FSS are chips and processed potatoes, meat products, butter and full-fat spreads, and creams, ice creams and desserts for both men and women. Similar findings were reported in other studies. Loughridge *et al.*[28] showed that meats and chips contributed 24% and 11%, respectively, to fat intake outside the home. This study is rather dated and it is possible that eating patterns may have changed; however, as there is a paucity of research in this area, it is important to make comparisons with papers that are available. Le Francois *et al.*[29] reported that meat and fish had the greatest contribution to fat at 27%, followed by bread, biscuits and pastries (18%), dairy products (14%) and fats and oils (11%).

Within the present study, the contribution of fat to energy across the days of the week was examined separately for men and women at home and outside the home using one-way ANOVA. This showed that while an effect of day of the week was evident at home, no such effect existed when eating outside the home. A number of other studies can be used to make broad comparisons. However, it is important to bear in mind the differences that exist between the studies. None of these other studies separates the data by location and the populations and data collection methodologies used vary. The present study has taken the analysis further by separating the data by location and showed that the significance of the day of the week effect was dependent on the location.

A number of other studies have examined the actual fat intakes rather than the contribution to energy. Gibson *et al.*[3] examined intakes among female university students and showed that a significant day of the week effect existed for total fat intake. Post *et al.*[4] showed that fat intake was higher among schoolgirls and schoolboys (age 12–17 years) on a weekend day than on a school day. De Castro *et al.*[5] also showed that fat intakes were significantly greater on weekend days (Friday to Sunday) than on Monday to Thursday in his study of 315 American adults (age 18–75 years). In contrast to these studies, St Jeor *et al.*[6] found that while intakes were highest on Friday, no significant main effect existed for day of the week. Nicklas *et al.*[7] also found that there was no significant difference between Sunday and weekdays for total fat intake among 10-year-old children.

Other studies examined the actual fat intake and also the contribution to energy, and again these provide conflicting results. In some studies, no significant day of the week effect existed for either actual fat intake or the contribution of fat to energy[8,9]. Beaton *et al.*[10], in a study of sales and office staff, found that a significant day of the week effect existed for intake of fat among women only. However, no significant effect was evident for the contribution of fat to energy among men or women. Similarly, in a study of 329 Hawaiian men, McGee *et al.*[11] found that significant differences existed between the days of the week for the actual intake of fat but not for the contribution of fat to energy. Conversely, Thomson *et al.*[12] showed that a significant day of the week effect existed for the contribution of fat to total and food energy but not for actual fat intakes among Scottish men. Jula *et al.*[13] examined three different study groups, one group over 7 days, a second group over 4 days (Thursday to Sunday) and a third population sample over 5 days (Monday,

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Tuesday and Friday to Sunday). Among the group over 7 days, a significant day of the week effect existed for the contribution of fat to energy but not for absolute fat intakes. Significant effects of day of the week were found for the actual fat intakes and the contribution of fat to energy in the other two groups.

In the present study, the data were not analysed by age group, as this would have produced too many tables giving results beyond the scope of this paper. However, previous research by our group has shown that younger people (18–35 years) tend to eat out more often than their older counterparts[30] and that the contribution of fat to food energy was lowest among the older respondents (51–64 years)[27]. This suggests that the results found in the present paper may apply more to those in the youngest age group.

Two main conclusions can be drawn from the present study, which elaborate on those found in a previous study on the FSS in this research group. First, the issue of alcohol in examining the contribution of fat to energy was further refined in the present study. This continues to highlight the need for careful consideration in deciding which energy value to use. Second, the contribution from fat was greater from foods consumed outside the home than at home on all days of the week. The foods that contribute most to fat at home and outside the home have been identified. This information can now be used in the development of public health nutrition guidelines for targeting a reduction in the contribution of fat to energy.

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Appendix – Detailed description of the 26 food groups used in this study

Food group	Foods contained within the food group
Rice & pasta	Rice & pasta (plain), flour, grains & starches
Savouries	Pizza, mixed pasta dishes, quiche
Bread	White bread, wholemeal bread, white & wholemeal rolls, soda bread, scones, bagels, croissants, ethnic breads
Breakfast cereals	Ready-to-eat breakfast cereals, porridge, Ready Brek
Biscuits, cakes & pastries	Biscuits, cakes, buns & pastries
Whole milk	Whole milk
Low-fat milk	Low-fat, skimmed, fortified, processed milks
Creams, ice creams & desserts	Creams, ice creams, puddings, chilled desserts, rice puddings, custard
Cheese	Cheese
Yoghurts	Yoghurts
Eggs & egg dishes	Eggs, egg dishes
Butter & full-fat spreads	Butter & full-fat spreads
Low-fat spreads	Low-fat spreads
Potatoes: boiled, mashed, baked	Boiled, mashed & baked potatoes
Chips & processed potatoes	Chipped, fried & roasted potatoes, processed potato products
Vegetables & vegetable dishes	All vegetables & vegetable dishes
Fruits, juices & nuts	All fruits, fruit juices, nuts, seeds, herbs & spices
Fish & fish products	Fish & fish products
Fresh meat	Bacon, ham, beef, veal, lamb, pork, chicken, turkey, game, pheasant, rabbit
Meat dishes	Offal dishes, beef, veal, lamb, pork, bacon, poultry or game dishes
Meat products	Burgers, sausages, meat pies, pastries, sausage rolls, puddings
Alcoholic beverages	Alcoholic beverages
Sugars & confectionery	Sugars, syrup, preserves, sweeteners, confectionery
Savoury snacks	Savoury snacks
Soups, sauces & miscellaneous foods	Soups, sauces & miscellaneous foods
Beverages	Tea, coffee, carbonated beverages, diet carbonated beverages, squashes & cordials

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