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The influence of eating location on nutrient intakes in Irish adults: implications for developing food-based dietary guidelines

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Abstract

Objectives: To examine the contribution of the food service sector to the nutrient quality of the Irish diet, and to compare intakes at home, work and outside the home ('out') and within the subgroups of the out location (pub, deli, takeaway).
Design and setting: Random sample of adults from the Republic of Ireland. Food intake data were collected using a 7-day food diary. Respondents recorded the location of every eating occasion determined by where the food was prepared rather than consumed.
Results: Intakes of energy, protein, fat and carbohydrate were significantly greater at home than at work or out ($P < 0.05$). The intake of alcohol was significantly ($P < 0.001$) greater out than at home or work. The percentage contribution of fat to energy was above the recommendations (33% of total energy and 35% of food energy) for both men and women at all locations, with the exception of the contribution of fat to total energy for men at the out location. Within the subgroups of the out location, the contribution of alcohol to total energy was greatest in pubs and the contribution of fat to both total and food energy was greatest in takeaways. Intakes of fibre and most micronutrients per 10 MJ of food energy were greater ($P < 0.05$) at home than at work or out.
Conclusion: Foods eaten outside the home contribute a disproportionately high level of fat intake and should be targeted in public health nutrition strategies.

Keywords
Food service sector
Macronutrients
Micronutrients
Ireland
Eating location
Alcohol

Due to increasing wealth and changing social conditions, the food service sector (FSS) is becoming increasingly important. A number of international studies have highlighted the increase in eating out of the home[1–9] and therefore the greater contribution from the FSS to nutrient intakes. This emphasised the need to examine the contribution of the FSS to the nutritional quality of the diet. Le Francois *et al.*[1], Gregory *et al.*[10] and the Department for Environment, Food and Rural Affairs (DEFRA), UK[11] have examined foods eaten outside the home. These studies reported that the contribution of fat to either total or food energy was higher and the contribution of carbohydrate to either total or food energy was lower than current recommendations[12]. A number of other studies have examined nutrient intakes from outside the home and compared them with those from within the home. Lin and Frazao[2], Loughridge *et al.*[13], Ries *et al.*[14] and Morabia *et al.*[15] all showed that the contribution of fat to energy from foods eaten outside the home was higher than that from foods eaten at home.

The proportion of food expenditure being spent outside the home is also increasing in many countries[1,3,11,16–18]. In Ireland, it increased from 16% in 1994/95 to 19% in 1999/2000[16,17]. Initial analysis of the North/South Ireland Food Consumption Survey[19] (NSIFCS) showed that 24% of energy came from foods outside the home, and 85% of men and 87% of women ate outside the home at least once during the survey week[20]. This indicates the importance of the FSS in Ireland and why a detailed study in this area is warranted.

The NSIFCS established a detailed database of habitual food and drink consumption of Irish adults, including the eating location for every item consumed based on where it was prepared[21]. This is the first study in Ireland that allows for the comparison of foods consumed at different locations. The aims of the present paper are to compare the quality of the diet at home, at work and outside the home and to examine in detail the quality of the diet in various locations of the FSS, with the intention of providing much needed information upon which public health nutrition strategies can be based.

Methods

The NSIFCS was carried out on a random representative sample of Irish adults, aged 18 to 64 years, from both the Republic of Ireland and Northern Ireland between 1997 and 1999. Data were collected on food intakes and a series

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of questionnaires was used to gather sociodemographic, physical activity and attitudinal data. Details of methods and sampling procedures from the survey have been previously published[21,22]. In this study, data from the Republic of Ireland only were used for analysis ($n = 958$).

Food intakes

A 7-day food diary was used to collect data on food and beverage intakes. Respondents recorded the day, date, time, location and meal type, as defined by the respondent, for each eating occasion as well as a description of the food, the quantity of the food, cooking method and recipes when necessary. The foods were coded using *McCance & Widdowson's The Composition of Foods*[23] and published supplements[24–32]. Nutrient intakes were calculated using WISP© (Weighed Intake Software Package; Tinuviel Software, Warrington, UK).

Locations

Eight eating location codes were used when entering the diaries into the database. These 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). Each eating occasion was coded based on where the food was prepared rather than where the food was eaten. For the purpose of the present study, the eight locations were aggregated to form three new locations and the abbreviated terms 'home', 'work' and 'outside the home' are used to describe them. '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. These were aggregated to form one location category as few eating occasions were recorded at a friend's home, at a relative's home, family home or meals on wheels. Analysis carried out showed that these did not differ substantially. '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). 'Outside the home' was further subdivided into 'pub' (5 and 8 above), 'deli' (6 above) and 'takeaway' (7 above). Collectively, these are referred to as the 'three out locations'.

Nutrient analysis

Mean daily macronutrient intakes ($g\,day^{-1}$) were calculated for home, work and outside the home and also for the three out locations. Mean daily intakes of fibre and micronutrients per 10 MJ of food energy (excluding ethanol) were also calculated for each location. The intakes were based on 7 days for the subjects who consumed at each particular eating location. This is subsequently referred to as consumers only at the location.

The percentage contribution of each macronutrient to both total and food energy (excluding ethanol) was calculated for men and women at each location. Alcohol intake was also converted to its unit value based on the quantity and type of alcohol in order to compare the findings with current guidelines[33]. Mean daily intakes of macronutrients and their contributions to total and food energy were compared with current guidelines and recommendations[12].

Further analysis of the contributions of fat to food energy was also carried out. First, the food energy value was calculated excluding the subjects who consumed alcohol only but no food. A second approach, removing the alcoholic beverage, was also examined. In calculating this value, the subjects mentioned above, i.e. those who consumed alcohol only, were automatically removed. The contribution to total and food (excluding ethanol and alcohol beverage) energy was also examined across tertiles of eating occasions including and excluding alcohol for the out location only.

Underreporting of energy intakes is inherent in food consumption surveys and can confound interpretation of the results. In this study underreporters were identified using a cut-off value of 1.05 for the mean ratio of energy intake to estimated basal metabolic rate[34,35]. On exclusion of these underreporters, very small differences in the percentage contribution of macronutrients to total and food energy were seen and so this study used the data from the entire sample.

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 nutrient intakes according to sex and eating location. Differences between men and women for each nutrient at each location were examined. The differences in nutrient intakes across the locations were also examined for men and women separately.

A two-way analysis of variance (ANOVA) was conducted to examine the impact of sex and location and sex and tertiles of the number of eating occasions on the macronutrient and micronutrient intakes. Values of $P < 0.05$ were considered statistically significant.

The intakes of macronutrients and their contributions to total and food energy at home, work and out were also analysed by age groups (data not shown) and a three-way ANOVA was carried out examining the effect of sex, location and age. Values of $P < 0.05$ were considered statistically significant.

Results

Table 1 presents the mean daily intakes of energy and macronutrients with their contributions to food and total energy for consumers only at each location for men and

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Table 1 Mean values and standard deviation (SD) for energy and macronutrient intakes in Irish adult males and females at different locations

		Males						Females						Two-way ANOVA (*P*-value)		
		Home (*n* = 475)		Work (*n* = 327)		Out (*n* = 411)		Home (*n* = 483)		Work (*n* = 275)		Out (*n* = 410)				
Nutrient	Target	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Sex (S)	Location (L)	S × L
Energy (MJ)		8.1	(3.2)	1.8	(1.7)	2.3	(1.9)	6.0	(2.2)	1.2	(1.1)	1.3	(1.1)	0.000	0.000	0.000
Protein (g)		77.3	(29.5)	15.2	(16.1)	16.3	(14.6)	56.7	(19.4)	10.1	(9.5)	9.6	(8.9)	0.000	0.000	0.000
Fat (g)		76.5	(35.4)	19.0	(18.8)	17.9	(17.8)	57.1	(25.1)	12.7	(12.1)	12.5	(11.5)	0.000	0.000	0.000
Carbohydrate (g)		236.3	(102.3)	53.5	(50.2)	46.3	(39.9)	176.2	(68.8)	36.8	(31.8)	28.4	(24.6)	0.000	0.000	0.000
Alcohol (g)		4.9	(9.8)	0.4	(2.4)	21.3	(28.7)	3.5	(7.0)	0.2	(1.1)	7.6	(11.6)	0.000	0.000	0.000
Percentage contribution to total energy																
Protein		16.4	(3.3)	13.0	(5.3)	11.6	(5.6)	16.2	(3.2)	13.6	(6.3)	11.7	(6.3)	0.391	0.000	0.300
Fat	≤33%	35.3	(6.1)	36.8	(12.0)	28.5	(15.3)	35.4	(6.6)	37.9	(11.0)	34.6	(14.5)	0.000	0.000	0.000
Carbohydrate	≥47%	45.7	(6.7)	49.1	(14.0)	32.9	(13.1)	46.1	(6.8)	47.8	(12.3)	36.1	(14.3)	0.113	0.000	0.001
Alcohol		2.0	(4.0)	0.8	(5.8)	26.9	(27.1)	1.7	(3.5)	0.6	(6.2)	17.1	(23.4)	0.000	0.000	0.000
Percentage contribution to food energy																
Protein		16.7	(3.3)	13.1	(5.3)	17.8	(13.0)	16.5	(3.2)	13.6	(6.3)	15.4	(11.9)	0.030	0.000	0.001
Fat*	≤35%	36.1	(6.0)	37.1	(11.8)	35.2	(14.9)	36.0	(6.8)	38.0	(11.0)	40.0	(13.9)	0.000	0.004	0.000
Fat†	≤35%	36.1	(6.0)	37.1	(11.8)	38.2	(11.1)	36.0	(6.8)	38.1	(10.8)	40.9	(12.6)	0.004	0.000	0.016
Carbohydrate	≥50%	46.6	(6.4)	49.5	(14.0)	47.4	(16.2)	46.9	(6.4)	47.8	(12.2)	44.2	(16.1)	0.003	0.000	0.010

ANOVA – analysis of variance.
* Mean for consumers at the location.
† Mean for consumers at the location excluding those who consumed alcohol only.

women. Sex and location had significant ($P < 0.001$) main and interaction effects on the absolute intakes. There was a significant main effect for sex on the contributions of fat and alcohol to total energy ($P < 0.001$) and for all macronutrients to food energy ($P < 0.05$). Location had a significant main effect for the contributions of all macronutrients to total ($P < 0.001$) and food energy ($P < 0.01$). A significant interaction effect was evident for sex and location on the contributions of fat, carbohydrate and alcohol to total energy ($P < 0.01$) and on the contributions of all macronutrients to food energy ($P < 0.05$).

The data were also analysed by age group (data not shown). Respondents were categorised into three groups (18–35, 36–50 and 51–64 years). Age had a significant main effect on the actual intakes of fat and alcohol and on the contributions of protein, fat and carbohydrate to both total and food energy. The actual intakes of fat and alcohol were greater in the youngest age group outside the home. The contributions of all macronutrients to total energy

Table 2 Mean values and standard deviation (SD) for energy and macronutrient intakes in Irish adult males and females for each of three eating out locations

		Males						Females						Two-way ANOVA (*P*-value)		
		Pub (*n* = 368)		Deli (*n* = 186)		Takeaway (*n* = 167)		Pub (*n* = 337)		Deli (*n* = 243)		Takeaway (*n* = 137)				
Nutrient	Target	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Sex (S)	Location (L)	S × L
Energy (MJ)		1.7	(1.4)	0.8	(1.1)	1.1	(0.8)	1.0	(0.8)	0.5	(0.5)	0.7	(0.5)	0.000	0.000	0.001
Protein (g)		11.4	(11.1)	5.5	(9.1)	8.9	(7.5)	7.1	(6.7)	3.4	(4.5)	5.2	(4.2)	0.000	0.000	0.097
Fat (g)		9.9	(11.4)	8.4	(12.7)	13.0	(10.4)	8.1	(8.1)	5.3	(6.4)	8.1	(5.8)	0.000	0.000	0.064
Carbohydrate (g)		28.5	(24.5)	21.4	(29.5)	27.2	(20.6)	18.6	(17.1)	12.4	(13.4)	17.2	(13.1)	0.000	0.000	0.932
Alcohol (g)		23.7	(29.4)	0.1	(1.0)	0.1	(0.7)	9.1	(12.1)	0.0	(0.3)	0.4	(1.7)	0.000	0.000	0.000
Percentage contribution to total energy																
Protein		10.8	(6.7)	10.2	(6.4)	13.8	(5.6)	11.5	(7.6)	11.1	(7.0)	12.7	(6.6)	0.565	0.000	0.102
Fat	≤33%	21.2	(17.3)	38.4	(15.9)	44.3	(9.4)	28.3	(17.4)	41.9	(15.3)	44.3	(9.4)	0.000	0.000	0.003
Carbohydrate	≥47%	27.7	(15.1)	49.4	(18.2)	40.8	(11.2)	31.2	(16.8)	46.8	(16.7)	41.0	(11.4)	0.704	0.000	0.005
Alcohol		40.3	(32.1)	1.5	(10.6)	0.4	(2.4)	28.8	(30.0)	0.1	(0.6)	1.0	(4.1)	0.001	0.000	0.000
Percentage contribution to food energy																
Protein		22.5	(19.8)	10.9	(9.0)	13.8	(5.6)	19.6	(20.1)	11.1	(7.0)	12.9	(6.7)	0.153	0.000	0.199
Fat*	≤35%	27.8	(19.3)	38.5	(15.8)	44.5	(9.5)	35.5	(18.7)	42.0	(15.3)	44.8	(9.3)	0.000	0.000	0.003
Fat†	≤35%	34.6	(15.1)	38.9	(15.3)	44.5	(9.5)	37.7	(16.8)	42.0	(15.3)	44.8	(9.3)	0.010	0.000	0.337
Carbohydrate	≥50%	50.9	(22.9)	50.3	(18.1)	40.9	(11.2)	45.4	(23.4)	46.8	(16.7)	41.4	(11.3)	0.010	0.000	0.084

ANOVA – analysis of variance.
* Mean for consumers at the location.
† Mean for consumers at the location excluding those who consumed alcohol only.

Table 3 Percentage of Irish adults adhering to current dietary recommendations for macronutrients and alcohol according to sex and eating location

	Males			Females			Males – Three out locations			Females – Three out locations		
	Home	Work	Out	Home	Work	Out	Pub	Deli	Takeaway	Pub	Deli	Takeaway
Protein (males 56 g, females 47 g)	75.4	2.4	1.9	70.0	0.4	0.0	0.3	1.1	0.0	0.0	0.0	0.0
Fat to total energy ≤33%	33.5	26.9	55.7	33.3	28.4	34.6	69.8	25.3	5.4	52.8	18.1	7.3
Fat to food energy ≤35%*	41.1	31.5	33.3	43.5	32.7	21.7	51.1	29.6	7.2	35.9	22.6	7.3
Fat to food energy ≤35%†	41.1	31.5	27.5	43.5	32.5	20.0	39.2	28.8	7.2	31.7	22.6	7.3
Carbohydrate to total energy ≥47%	42.7	49.2	11.7	44.1	48.0	17.6	7.9	48.4	25.1	13.1	40.3	24.8
Carbohydrate to food energy ≥50%	29.1	39.4	31.1	31.9	37.5	24.6	41.3	39.2	10.2	28.8	32.5	13.9
Alcohol units (<21 males, <14 females)‡	91.0	100.0	63.0	88.1	100.0	79.7	62.6	100.0	100.0	79.3	100.0	100.0

* Percentage of all consumers at the location.
† Percentage of consumers at the location excluding those who consumed alcohol only.
‡ Percentage of alcohol consumers only at each location.

remained relatively constant across the age groups in all locations. However, the contribution of fat to food energy was lowest in the oldest age group in all three locations, with the greatest difference in the out location. Sex and age had a significant interaction effect on the contribution of fat to total energy and carbohydrate to food energy. Location and age had a significant interaction effect on the actual intakes of energy and macronutrients and on the contributions of protein and carbohydrate to food energy. A significant interaction effect of sex, location and age existed only on the contribution of alcohol to total energy.

Table 2 presents the mean daily intakes of macronutrients and their contribution to total and food energy for consumers only at each of the three out locations. Sex and location had significant ($P < 0.001$) main effects on the absolute intakes of energy and all macronutrients. Interaction effects were significant ($P < 0.01$) for the intakes of energy and alcohol only. Sex had a significant main effect on the contributions of fat and alcohol to total energy ($P < 0.01$) and on the contributions of both fat values and carbohydrate to food energy ($P < 0.05$). Location had a significant ($P < 0.001$) main effect on the contributions of all macronutrients to total and food energy. An interaction effect existed for the contributions of fat, carbohydrate and alcohol to total energy ($P < 0.01$) and for the contribution of fat, including alcohol only consumers, to food energy ($P < 0.01$).

Table 3 presents the percentage of consumers who met the recommendations for macronutrient intakes at each location. Approximately three-quarters of both men and women at home met the recommendation for protein (56 g for men, 47 g for women) intake. The recommendation for the percentage of food energy from fat (≤35%) was met by over 40% of men and women at home. One-third of men and one-fifth of women met this recommendation outside the home. When the three out locations were examined, it was evident that a greater number achieved the recommendation for fat in pubs (51% and 36% of men and women, respectively). However, this dropped to 39% of men and 32% of women when those who consumed alcohol only were removed. In takeaways, only 7% of men and women achieved the recommendation.

Table 4 presents the percentage contributions of fat to total energy, food energy (excluding ethanol) and food

Table 4 Mean percentage contribution and standard deviation (SD) of fat to energy in Irish adults for outside the home only across tertiles of eating occasions for both men and women

	Male Low Mean	Male Low SD	Male Medium Mean	Male Medium SD	Male High Mean	Male High SD	Female Low Mean	Female Low SD	Female Medium Mean	Female Medium SD	Female High Mean	Female High SD	Two-way ANOVA (P-value) Sex (S)	Frequency (F)	S × F
Frequency of eating occasions including alcohol consumers	1 to 3 (n = 106)		4 to 8 (n = 143)		9 to 51 (n = 162)		1 to 2 (n = 140)		3 to 5 (n = 168)		6 to 24 (n = 102)				
Total energy	31.0	18.5	28.4	14.6	26.8	13.4	36.8	16.3	35.1	13.0	30.6	13.3	0.000	0.000	0.493
Food energy (excluding ethanol)	33.5	18.4	35.3	13.8	36.1	13.3	39.3	16.4	41.0	11.6	39.4	13.4	0.000	0.317	0.525
Frequency of eating occasions excluding alcohol consumers	1 to 2 (n = 162)		3 to 5 (n = 84)		6 to 19 (n = 132)		1 to 2 (n = 96)		3 to 4 (n = 190)		5 to 16 (n = 115)				
Food energy (excluding alcoholic beverage)	40.5	14.4	43.0	7.2	42.3	7.4	41.7	16.1	41.2	12.7	42.4	9.5	0.821	0.443	0.376

ANOVA – analysis of variance.

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Table 5 Mean values and standard deviation (SD) for intakes of fibre and micronutrients per 10 MJ in Irish adult males and females at different eating locations

	Males						Females						Two-way ANOVA (*P*-value)		
	Home ($n = 475$)		Work ($n = 327$)		Out ($n = 411$)		Home ($n = 483$)		Work ($n = 275$)		Out ($n = 410$)				
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Sex (S)	Location (L)	S × L
Southgate fibre (g)	23.7	(7.0)	21.4	(16.7)	14.8	(9.8)	24.7	(7.6)	22.3	(13.2)	16.0	(9.7)	0.018	0.000	0.980
Calcium (mg)	921.1	(273.8)	1042.1	(666.3)	963.1	(1139.1)	997.1	(286.9)	1222.6	(850.1)	893.4	(990.5)	0.049	0.000	0.007
Iron (mg)	13.9	(3.6)	9.8	(4.6)	17.2	(15.9)	15.0	(5.8)	11.1	(9.0)	11.2	(8.4)	0.001	0.000	0.000
Copper (mg)	1.4	(0.9)	1.6	(1.9)	1.3	(1.3)	1.5	(0.8)	1.7	(1.9)	1.2	(1.1)	0.352	0.000	0.166
Zinc (mg)	11.6	(3.1)	8.4	(4.2)	8.2	(5.8)	11.2	(2.8)	8.5	(5.0)	7.5	(4.9)	0.085	0.000	0.154
Vitamin E (mg)	6.1	(3.1)	6.4	(5.4)	5.8	(5.6)	7.7	(3.9)	8.4	(6.6)	7.8	(6.1)	0.000	0.072	0.613
Thiamin (mg)	2.2	(0.6)	1.6	(0.9)	1.2	(0.8)	2.2	(0.6)	1.6	(0.8)	1.2	(0.7)	0.877	0.000	0.317
Riboflavin (mg)	1.9	(0.7)	1.6	(1.0)	4.0	(9.2)	2.0	(0.8)	1.9	(1.5)	2.7	(7.5)	0.159	0.000	0.002
Vitamin B_6 (mg)	3.0	(0.9)	2.0	(1.5)	8.1	(14.6)	3.7	(8.4)	2.0	(1.4)	4.5	(11.5)	0.008	0.000	0.000
Vitamin B_{12} (μg)	5.4	(5.0)	3.5	(3.8)	3.9	(4.1)	5.5	(4.3)	4.2	(6.0)	3.6	(4.2)	0.605	0.000	0.104
Vitamin C (mg)	86.6	(76.6)	98.0	(284.6)	53.9	(70.3)	104.9	(71.0)	94.1	(132.0)	69.4	(121.2)	0.083	0.000	0.264
Vitamin A (μg)	973.6	(1164.1)	701.8	(961.9)	755.6	(1021.5)	1204.3	(1090.0)	910.7	(1337.4)	871.9	(935.3)	0.000	0.000	0.516

Table 6 Mean values and standard deviation (SD) for intakes of fibre and micronutrients per 10 MJ in Irish adult males and females for each of three eating out locations

	Males						Females						Two-way ANOVA (*P*-value)		
	Pub ($n = 368$)		Deli ($n = 186$)		Takeaway ($n = 167$)		Pub ($n = 337$)		Deli ($n = 243$)		Takeaway ($n = 137$)				
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Sex (S)	Location (L)	S × L
Southgate fibre (g)	12.8	(11.2)	15.3	(16.8)	16.1	(7.7)	16.7	(23.5)	15.9	(14.2)	14.8	(9.0)	0.233	0.651	0.034
Calcium (mg)	1347.8	(1761.5)	860.4	(522.8)	474.5	(383.8)	1216.3	(1791.1)	966.4	(759.0)	444.1	(344.3)	0.800	0.000	0.336
Iron (mg)	22.4	(21.6)	9.6	(12.9)	9.4	(4.2)	12.6	(11.7)	8.8	(4.9)	8.8	(4.4)	0.000	0.000	0.000
Copper (mg)	1.3	(1.7)	1.5	(2.9)	1.1	(0.5)	1.3	(1.6)	1.0	(0.9)	1.0	(0.5)	0.030	0.074	0.097
Zinc (mg)	8.7	(7.8)	5.9	(3.9)	6.7	(5.9)	7.7	(5.8)	6.7	(4.2)	5.5	(5.2)	0.156	0.000	0.020
Vitamin E (mg)	4.6	(5.0)	6.8	(7.6)	7.8	(9.8)	7.2	(6.8)	8.3	(7.1)	8.3	(10.0)	0.000	0.000	0.122
Thiamin (mg)	1.1	(1.0)	1.6	(7.0)	1.2	(0.6)	1.2	(0.9)	1.3	(1.1)	1.1	(0.6)	0.664	0.241	0.548
Riboflavin (mg)	7.4	(14.5)	1.9	(7.1)	0.9	(0.5)	5.2	(14.2)	1.5	(1.2)	0.9	(0.6)	0.150	0.000	0.221
Vitamin B_6 (mg)	14.7	(23.1)	2.0	(4.2)	2.2	(0.8)	8.8	(21.4)	1.6	(1.8)	2.3	(0.9)	0.017	0.000	0.003
Vitamin B_{12} (μg)	4.0	(6.6)	3.3	(7.0)	3.9	(3.6)	3.6	(5.0)	3.2	(3.9)	3.1	(4.5)	0.174	0.216	0.695
Vitamin C (mg)	51.2	(74.2)	69.1	(198.9)	49.5	(45.0)	96.6	(349.4)	66.9	(237.5)	55.0	(103.2)	0.179	0.340	0.144
Vitamin A (μg)	906.3	(1357.1)	592.3	(981.6)	260.3	(318.6)	978.4	(1077.3)	864.1	(1105.0)	260.0	(500.4)	0.053	0.000	0.172

energy (excluding alcoholic beverages) for the outside the home location only, according to sex and frequency of eating occasion. Sex had a significant main effect ($P < 0.001$) on the contribution to both total and food energy across the tertiles of the frequency of eating occasions including alcohol. The frequency had a significant ($P < 0.001$) main effect for the contribution to total energy. The interaction effect did not reach statistical significance. For the contribution to food energy across the tertiles excluding alcoholic beverages, sex and frequency had neither a significant main effect nor a significant interaction effect.

Table 5 presents the mean daily intakes of fibre and micronutrients per 10 MJ of food energy at each location for men and women. Sex had a significant ($P < 0.05$) main effect on the intakes of fibre, calcium, iron, and vitamins E, B_6 and A. Location had a significant ($P < 0.001$) main effect on the intakes of all micronutrients except vitamin E. A significant ($P < 0.01$) interaction effect was evident for the intakes of calcium, iron, riboflavin and vitamin B_6.

Intakes of fibre and micronutrients per 10 MJ of food energy for men and women at the three out locations are shown in Table 6. Sex had a significant ($P < 0.05$) main effect on the intakes of iron, copper, and vitamins E and B_6. Location had a significant ($P < 0.001$) main effect on the intakes of calcium, iron, zinc, vitamin E, riboflavin, and vitamins B_6 and A. A significant ($P < 0.05$) interaction effect was evident for fibre, iron, zinc, and vitamin B_6.

Discussion

The FSS has become increasingly important on a global scale, with the proportion of food expenditure being spent outside the home increasing in many countries[1,3,11,16–18]. In spite of this apparent importance of the FSS, only 16 studies pertaining to this area were found in the literature. However, relatively few of these can be used to make direct comparisons with the present study because of several methodological differences, such as different sample sizes, populations, study aims and classification of locations.

The sample size used in the various studies varied greatly from 70 respondents[13] to 63 880 respondents[36], with the latter based on a number of surveys in the USA. Most of the studies had a population of between 1000 and 3500 respondents. In addition, the population characteristics also differed between studies. Some examined data for women only[4–6], while others examined specific age groups[5,7]. Most of the studies examined the adult population but the actual age profiles still differed[1,8–10,13–15].

The studies also varied in their purpose. Some, similar to the NSIFCS, examined food and nutrient intakes and incorporated the FSS as an element[2,6,10,11,14,36]. In these instances, nutrient quality of the diet in the FSS was compared with nutrient quality at home. Other studies focused on intakes of fast foods or the frequency of fast-food restaurant use[5,7–9]. These studies analysed the association between nutrient intakes or body weight parameters and fast-food intake or frequency of consumption in a restaurant.

The classification of the out location also varied between studies. Some had a detailed breakdown of the FSS[2,6,9,13,14,36], while other studies did not need to categorise the locations as they focused on fast food only[5,7]. None of the above studies analysed the possibility of underreporting, with only two studies acknowledging that it may need to be taken into account. However, as many of the studies focused on a specific area, for example fast food, they were not designed to gather enough data to identify underreporters.

In the present study, two significant potentially confounding issues were identified, namely the inclusion of only those subjects who consumed food outside the home and the issue of including alcohol. The number of respondents at different eating locations excludes individuals who, in the space of the 7-day survey, did not record at least one instance of eating at a particular location. While this excludes unnecessary zero values, it means that comparisons of means across different locations involves groups of unequal size. Since even one instance of eating at a given location merits inclusion in that group, the variability increases in samples outside the home as it less likely for all respondents to eat outside the home every day. The coefficient of variation changes dramatically across the different locations. For example, in the case of percentage of total energy from fat for men, the coefficient of variation rises from 17% at home, to 33% at work and to 54% out. It is therefore wise to suggest that, when studies of eating locations are compared, the inclusion or exclusion of non-consumers at a given location needs to be considered and the variability around the mean may be as informative as the mean itself.

A second major methodological issue considered in the present study was the basis for calculating the contribution of macronutrients to energy intake. In most studies, it is usual to encounter the contribution of macronutrients to total energy (including ethanol) and food energy (excluding ethanol). However, examining the contribution to food energy includes individuals who consume alcohol only. For example, in examining the intakes in pubs, there were 72 men and 22 women who consumed alcohol only and therefore, in calculating the percentage contribution from fat, most of these individuals had zero values. It was found that the percentage contribution of fat to food energy was approximately 8% higher for women than men. When the individuals who consumed alcohol only were removed, the percentage contribution of fat increased for both men and women, from 28% to 36% and 35% to 38%, respectively. While the difference between men and women remained statistically significant, the difference was far less. Since the present study focuses on the FSS, it was deemed unwise to confound any analysis of its contribution to food through alcohol-only energy.

A further refinement to the issue of alcohol beverage consumption was also needed. Individuals may be included in the out locations by virtue of both food and alcohol beverage intakes. While the impact of ethanol can be corrected for by its exclusion, alcoholic beverages can contain considerable non-ethanol energy. For example, an average beer contains 68% energy from alcohol, 4% energy from protein and 28% energy from carbohydrate. Therefore, analysis was also carried out excluding alcoholic beverages. Thus in Table 4, the contribution of fat for men in the lowest tertile was 31% of total energy, 33.5% of food energy excluding ethanol and increased dramatically to 40.5% of food energy when the entire alcoholic beverage was excluded. It is also worth noting that when the entire alcoholic beverage was excluded from the analyses, increasing tertile of eating occasions out was not associated with changes in the percentage contribution of fat. It is therefore evident that when examining the contribution of fat to energy in the FSS, the manner in which alcoholic beverages are dealt with needs careful consideration.

Notwithstanding the difficulties in comparing studies on the FSS and allowing for the methodological issues identified in the present study, the basic conclusion is broadly comparable to most previous studies. Foods eaten outside the home have a greater probability of being higher in fat and lower in fibre and micronutrients than foods consumed inside the home. Results from the present study have shown that the contribution of fat to total energy was higher at home and work than outside the home. Loughridge *et al.*[13] reported similar results, with the contribution of fat being higher at home than outside the home. Lin and Frazao[2] reported a contribution of 37.6% of fat to total energy outside the home. Both these studies classified location in the same manner as the present study. In the UK, DEFRA[11] carried out a separate National Food Survey on Eating Out and reported a 39.7% contribution of fat to total energy outside the home. These values are higher than the results in this study (28.5% for men, 34.6% for women); however, these studies acknowledge the possibility of underreporting[2,11]. DEFRA[11] also reported a far lower contribution of alcohol to total energy outside the home than the NSIFCS, which may also account for some of the differences in fat contributions between the two studies. Similar results for the contribution to food energy, as was found in the present study, were reported by Gregory *et al.*[10] (39.9% for men and 41.9% for women) and Le Francois *et al.*[1] (approximately 42%). Gregory *et al.*[10] classified location based on where the food was eaten regardless of preparation, while Le Francois *et al.*[1] examined consumption of food and drink outside the home excluding any food taken from the home or anything consumed in a friend's house. It is also important to note that of the locations outside the home where food was consumed, the highest percentage contribution from fat was in the takeaway category at 45% of energy. Owing to the nature of the foods consumed in this location, a reduction in fat may be difficult to achieve. However, a change in the fat profile could be advocated by changing the fat used in cooking to one with a lower saturated fat content.

The contribution of carbohydrate to both total and food energy was below the recommendation at home and outside the home for men and women in the present study. Gregory *et al.*[10], Le Francois *et al.*[1], Morabia *et al.*[15] (examining consumption at home and in restaurants) and Loughridge *et al.*[13] all reported that the contribution of carbohydrate to energy outside the home was below the recommendations[12].

Similar to the present study, Lin and Frazao[2] reported that fibre intakes were lower away from home. Intakes of most micronutrients per 10 MJ were greater at home than outside the home for both men and women in the present study. Ries *et al.*[14] examined consumption at home and away from home, the latter included food obtained in restaurants, fast-food outlets and shops. That study found that a number of micronutrients per 1000 kcal were higher at home than outside the home (calcium, phosphorus, vitamin A, thiamin, riboflavin, vitamins B_6 and B_{12}), as did Lin and Farzao[2] (calcium and iron).

The results of the present study provide baseline data from which public health nutrition programmes may be built to address issues arising from the FSS. The first important point is that when the confounding effects of ethanol or alcoholic beverages are excluded, the estimated contribution of fat to energy increases. Therefore, consideration is required in deciding which energy value to use, i.e. if the ethanol or alcohol beverage is removed, as the resulting health promotion strategies for fat could be very different. Second, the contribution of fat to energy is above recommendations[12], reaching almost 45% in the takeaway sector, indicating that this is one possible area that could be targeted for fat reduction. As eating out becomes more popular, people should be encouraged to make healthier choices. Thus at this initial stage, the FSS can be identified as an area of food intake where significant reductions in fat intake might be achieved.

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