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Analysis of the temporal intake of cereal and dairy products in Irish adults: implications for developing food-based dietary guidelines

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Abstract

Objectives: To analyse the temporal distribution of the intake of cereal and dairy products in the Republic of Ireland.
Design: The North/South Ireland Food Consumption Survey established a database of habitual food and drink consumption using a 7-day food diary. The database also recorded the time and day of food consumption. Mean intakes of cereal and dairy products were calculated for time of the day and day of the week.
Results: At the weekend, the percentage of consumers decreased for nearly all cereal and dairy products. White bread, total cereals, full-fat milk and total dairy intakes were significantly lower at the weekend ($P < 0.01$) compared with weekdays. Intakes of cereal and dairy products over time of the day showed clear mealtime or snacking patterns when the number of consumers was controlled for. White bread, wholemeal bread, total cereals, full-fat milk, reduced-fat milk and total dairy intakes showed mealtime peaks for morning, afternoon and evening. When examined by tertile of intake, tertile of percentage energy from fat and tertile of fibre intake, intakes of cereal and dairy products over time of the day and day of the week were similar to trends described above, regardless of the tertile.
Conclusions: Temporal analysis of the intakes of cereal and dairy products did not reveal any unusual trends in this population. However, the significant methodological issues raised in this paper will be of benefit to other aspects of research in this area.

Keywords
Ireland
Cereal intake
Dairy intake
Temporal analysis
Food-based dietary guidelines

In 1995, a joint Food and Agriculture Organization/World Health Organization consultation called for the establishment of food-based dietary guidelines (FBDG) to translate nutrient goals into food-based guidelines. It also declared that FBDG need to be based on prevailing patterns of food and nutrient intake of the country and be practical, comprehensible and culturally acceptable to the population for which they are being developed[1]. The Eurodiet project was set up to define practical European guidelines for diet-related disease prevention and health promotion[2]. As set out by the Eurodiet series, one of the considerations of defining FBDG within a cultural context covers 'not only eating patterns in terms of what foods are commonly or randomly consumed, but also, when they are consumed'[3].

Although temporal analyses of nutrient intakes have been carried out[4,5], a temporal analysis of food intakes has not been carried out in relation to FBDG. Only three studies found in the literature examine food intake over day of the week, but do so in relation to survey duration and not the development of FBDG[6–8]. This paper is the first of its kind to examine the temporal distribution of food intakes in Ireland with a view to formulating FBDG.

Temporal analysis of food intakes could be very useful for the development of health strategies. Policy-makers would know whether to target increased consumption of certain foods during the week or at weekends, or whether, at certain times of the day, different macronutrient balances require specific attention. For example, previous research has shown that calcium and fibre intakes are lower than recommended in a substantial proportion of the Irish population[9,10], and that dairy products are an important source of calcium while cereal products are an important source of fibre in the Irish diet[11]. A temporal analysis of cereal and dairy products could potentially show when intakes of cereal and dairy products could be increased, or when the percentage of consumers of these foods could be increased, in order to increase the intakes of calcium and fibre in the population. The North/South Ireland Food Consumption Survey (NSIFCS) database can facilitate the temporal analysis of food consumption, as it provides information on the day and time of every eating occasion throughout the survey week.

The present paper sets out to describe the intakes of cereal and dairy products over time of the day and day of the week for potential use in the formulation of FBDG, and to examine the methodological issues that arise during a temporal analysis of food intakes.

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Methods

Survey sample

The NSIFCS collected food intake data from a random representative sample of adults (aged 18–64 years) from Northern Ireland and the Republic of Ireland. Data were collected from 1997 to 1999, with no particular time period excluded. Data collection was seasonally balanced and divided into two seasons: winter (September–February) and summer (March–August). A 7-day food diary was used to record food intake, and details of the time and day of food consumption were also collected. The food records were analysed using WISP© (Weighed Intake Software Program; Tinuviel Software, Warrington, UK). WISP uses McCance and Widdowson's food composition tables and published supplements to generate nutrient data[12–21]. Only data from the Republic of Ireland ($n = 958$) were used in the present study. A more detailed account of the sampling procedure and methodologies for this survey has been given elsewhere[22,23].

Database

The main nutrient database (food file) consists of approximately 160 000 rows of data that describe every food and drink item consumed by each respondent for every meal for each of the seven recording days. It also contains the day of the week and the time of the day at which the food was consumed. For the purposes of the present study, a new variable 'hour' was created which represented the 30 minutes before and the 29 minutes after the hour (e.g. all foods consumed between 06.30 and 07.29 hours were re-coded as having been consumed at 07.00 hours). As foods consumed between the hours of 01.00 and 06.00 (inclusive) accounted for only 1.6% of the total food consumed and there were few consumers at each time point, foods consumed during that time period have been excluded from these analyses.

Food groups

All cereal and dairy products in the food file were aggregated to form one of 11 food groups. Within the groups of cereal foods, wholemeal bread contained wholemeal and brown bread and rolls; cakes contained cakes, pastries, buns, scones and biscuits; breakfast cereals contained ready-to-eat breakfast cereals and other breakfast cereals; and total cereals was all cereal products reported along with other breads such as pizza, pitta bread and tomato bread. Within the groups of dairy foods, reduced-fat milk contained skimmed and low-fat milks and total dairy contained full-fat milk, reduced-fat milk, cheese, yoghurt, cream and ice cream. Cereal and dairy products from recipes were not included in this analysis because to do would not give a true representation of the times at which cereal or dairy products were consumed, as people consume whole foods and not ingredients.

Data analysis

Data analysis was carried out using SPSS® version 10.0 (SPSS Inc., Chicago, IL, USA). Means and standard deviations were determined for intakes of cereal and dairy products (g) for each day and hour. The mean values were determined for consumers of the food group only and not for the total population. Intakes of cereal and dairy products by day of the week were calculated by summing the amount of each food group consumed every day by each respondent, then calculating the mean per day for these consumers. Thus, the total amount consumed on a particular day could be compared with the total amount consumed on any other day. The percentage of consumers of each food group was also calculated for each day.

In contrast to the above, intakes per hour were computed by calculating the mean amount of cereal and dairy products consumed by each respondent at each hour, then calculating the mean per hour for these consumers. Thus, the amount consumed per hour reflected the average amount consumed at the hour regardless of the day, and did not show the total amount of the food group consumed at that hour over the course of the week. The percentage of consumers was also calculated for each hour. To control for the small number of consumers at some hours, the amount of each food group consumed at each hour was expressed as a percentage of the total food group consumed over the week for each individual.

Mean intakes of cereal and dairy products by day and by hour were also examined by tertiles of cereal and dairy consumption and tertiles of fat (percentage contribution to energy) and fibre (g per MJ of energy) intake. These two nutrients were chosen because of their public health nutrition importance in Ireland as found by Harrington *et al.*[24] and Galvin *et al.*[10].

Statistics

The data were assessed for normality. As they did not fit a normal distribution, the data were transformed using a square-root transformation to normalise them, which allowed for parametric tests to be performed. A two-way analysis of variance (ANOVA) was used to determine whether significant differences in food group intakes existed between day of the week and sex and whether an interaction effect was present between the variables (i.e. day of the week and sex). A three-way ANOVA was used to determine whether significant differences in food group intake existed between day of the week, sex and age group or tertile groups (of cereal and dairy consumption, fat intake or fibre intake), and whether an interaction effect was present between the variables. When significant differences existed, homogeneity of variance was tested using Levene's test. For values that complied with Levene's test, the Scheffe *post hoc* test was used to identify the mean values that differed significantly. The Tamhane *post hoc*

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was used for those that did not comply with Levene's test. Values at $P < 0.05$ were taken as significantly different.

Results

Table 1 shows the mean intake (g) and percentage of consumers for each of the cereal and dairy food groups over day of the week. Two-way ANOVA identified significant main effects for sex and weekday but there was no significant interaction effect between them. Men had significantly higher intakes of all cereal and dairy products than women (data not shown) ($P < 0.05$). The intake of white bread on Sunday was significantly lower than on all other days except Saturday ($P < 0.001$). The intake of total cereals was significantly lower on Sunday than all other days of the week ($P < 0.001$). The intake of full-fat milk on Sunday was significantly lower than intakes on Monday to Thursday ($P < 0.01$), while intakes of total dairy on Saturday and Sunday were significantly lower than intakes on Monday to Thursday ($P < 0.01$). Intakes of breakfast cereals, cheese and yoghurt also decreased very slightly at the weekend, but not significantly so. Intakes of wholemeal bread, cakes, rice and pasta and reduced-fat milk showed little variation over the course of the week. The percentage of consumers for nearly all cereal and dairy food groups also decreased on Saturday and/or Sunday. Three-way ANOVA did not identify any significant interaction effects for age, sex and weekday or age and weekday (data not shown).

Table 2 presents the mean intake (g) and percentage of consumers for each cereal and dairy food group over hour of the day. Mean intakes of cereal and dairy products across hour of the day did not show clear patterns, as small numbers of consumers at certain hours skewed the data. However, when percentage of consumers was examined, definite temporal patterns emerged for each of the food groups. The percentage of consumers of white bread, wholemeal bread, total cereals, full-fat milk, reduced-fat milk and total dairy showed consistent mealtime peaks for morning (07.00–11.00 hours), afternoon (13.00–15.00 hours) and early evening (18.00–20.00 hours). Percentage of consumers of cakes showed a snacking pattern throughout the day. Rice and pasta consumers demonstrated a slight afternoon and a main early evening peak. Percentage of consumers of breakfast cereals showed a definite morning peak. Cheese and yoghurt consumers demonstrated mainly afternoon peaks along with smaller peaks in the evening.

In an attempt to further clarify patterns of cereal and dairy consumption throughout the day, the intake of cereal and dairy products at each hour was expressed as a percentage of the total of each food group consumed over the week (Table 3). Intakes of white bread showed the same mealtime peaks as had percentage of consumers, but with intakes in the afternoon much higher than in the morning or early evening. Wholemeal bread also showed the same pattern, but with intakes in the morning and afternoon higher than intakes in the evening. Cakes still demonstrated a snacking pattern, but with slightly higher intakes in the earlier part of the day. Rice and pasta, breakfast cereals, total cereals and full-fat milk showed very similar patterns as were shown with percentage of consumers. Reduced-fat milk still showed mealtime patterns, but with consumption in the morning much higher than at the other mealtimes. Cheese and yoghurt also showed the same afternoon and early evening peaks, but clearly higher consumption in the afternoon. They also showed a slight late morning (10.00–11.00 hours) peak. Total dairy revealed the same mealtime peaks as percentage of consumers.

Intakes of cereal and dairy products by day of the week were analysed by tertile of cereal and tertile of dairy product consumption, and are presented in Tables 4 (cereal products) and 5 (dairy products). For low (i.e. those in the first tertile) and medium (i.e. those in the second tertile) consumers of white bread, wholemeal bread, cakes, rice and pasta, breakfast cereals, full-fat milk and cheese, the intakes remained relatively constant over the course of the week. However, high consumers (i.e. those in the third tertile) of white bread, breakfast cereals, full-fat milk and reduced-fat milk had lower intakes at the weekend than during the week. All consumers of total cereals and total dairy had lower intakes on Saturday and/or Sunday regardless of tertile. A three-way ANOVA showed main effects of sex and tertile for all cereal and dairy products and main effects of weekday for white bread, total cereals, full-fat milk, reduced-fat milk and total dairy. It also showed interaction effects of weekday and tertile of consumption for white bread ($P < 0.001$), full-fat milk ($P < 0.01$) and total dairy ($P < 0.01$). Further examination of the interaction effect revealed that differences across day of the week were significant only for high consumers of white bread, high consumers of full-fat milk and medium and high consumers of total dairy.

Intakes of cereal and dairy products over day of the week were also examined by tertile of percentage energy from fat and tertile of fibre intake (per MJ of energy) (data not shown). A three-way ANOVA did not show an interaction effect of weekday and tertile of fat or fibre. Overall, a decrease at the weekend was observed for intakes of white bread, breakfast cereals, total cereals, full-fat milk, cheese (for tertiles of fibre intake only) and total dairy.

Mean intakes of cereal and dairy products by tertile of intake, (percentage energy from) fat or fibre (per MJ of energy) per hour did not show any clear patterns due to small numbers of consumers at certain hours. Again, this was controlled for by expressing the intakes of cereal and dairy products at each hour as a percentage of the total consumed for each of the tertiles. In general, the same mealtime patterns emerged for all cereal and dairy products as described above for Table 3, regardless of

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Table 1 Mean intakes of cereal and dairy products (g) over day of the week for consumers (cons) only from the Republic of Ireland

	White bread			Wholemeal bread			Cakes			Rice & pasta			Breakfast cereals			Total cereals		
	Mean	(SD)	% Cons	Mean	(SD)	% Cons	Mean	(SD)	% Cons	Mean	(SD)	% Cons	Mean	(SD)	% Cons	Mean	(SD)	% Cons
Monday	118[a]	(76)	73	117	(77)	57	79	(69)	58	196	(114)	26	84	(92)	71	248[a]	(156)	99
Tuesday	120[a]	(82)	70	120	(84)	59	81	(68)	61	203	(110)	32	83	(86)	69	260[a]	(162)	99
Wednesday	120[a]	(81)	72	122	(94)	55	82	(60)	61	206	(111)	24	83	(91)	71	256[a]	(162)	99
Thursday	121[a]	(76)	77	123	(83)	56	79	(61)	62	178	(75)	21	83	(91)	71	256[a]	(159)	99
Friday	121[a]	(81)	74	123	(96)	57	78	(67)	57	190	(111)	27	82	(83)	68	258[a]	(163)	99
Saturday	111[ab]	(70)	76	122	(88)	52	85	(72)	51	203	(115)	24	76	(80)	63	242[a]	(160)	98
Sunday	99[b]	(61)	69	114[NS]	(84)	54	74[NS]	(62)	52	209[NS]	(108)	16	72[NS]	(73)	54	207[b]	(137)	96

	Full-fat milk			Reduced-fat milk			Cheese			Yoghurt			Total dairy		
	Mean	(SD)	% Cons	Mean	(SD)	% Cons	Mean	(SD)	% Cons	Mean	(SD)	% Cons	Mean	(SD)	% Cons
Monday	260[a]	(211)	84	224	(157)	83	46	(39)	38	136	(55)	44	307[a]	(215)	96
Tuesday	258[a]	(228)	86	219	(159)	83	43	(29)	39	141	(59)	39	309[a]	(229)	96
Wednesday	263[a]	(232)	85	229	(180)	84	44	(32)	39	141	(65)	39	312[a]	(238)	97
Thursday	259[a]	(228)	85	221	(184)	82	45	(34)	42	132	(52)	39	305[a]	(235)	97
Friday	247[ab]	(244)	87	206	(175)	85	44	(28)	43	136	(53)	37	299[ab]	(247)	96
Saturday	232[ab]	(213)	82	211	(155)	78	44	(34)	37	140	(70)	29	271[bc]	(214)	96
Sunday	217[b]	(186)	80	206[NS]	(147)	81	39[NS]	(29)	31	127[NS]	(55)	22	259[c]	(195)	96

SD – standard deviation.
[abc]Mean values with unlike superscripts are significantly different ($P < 0.05$) over day of the week by two-way analysis of variance; NS, not significant.

Table 2 Mean intakes of cereal and dairy products (g) over time of the day in consumers (cons) only from the Republic of Ireland

	White bread			Wholemeal bread			Cakes			Rice & pasta			Breakfast cereals			Total cereals		
	Mean	(SD)	% Cons	Mean	(SD)	% Cons	Mean	(SD)	% Cons	Mean	(SD)	% Cons	Mean	(SD)	% Cons	Mean	(SD)	% Cons
07.00	55	(30)	11	71	(42)	10	38	(22)	2	0		0	68	(67)	20	62	(44)	22
08.00	52	(25)	30	70	(48)	26	49	(36)	4	0		0	76	(82)	48	66	(54)	54
09.00	54	(25)	37	70	(33)	35	62	(55)	5	0		0	75	(78)	52	66	(46)	62
10.00	63	(33)	41	74	(41)	31	59	(41)	16	0		0	74	(85)	41	69	(50)	65
11.00	63	(32)	36	79	(44)	24	52	(37)	32	42		0	70	(75)	26	64	(42)	65
12.00	66	(33)	24	81	(49)	13	54	(46)	21	129	(89)	2	59	(48)	11	66	(43)	45
13.00	78	(30)	56	87	(41)	41	52	(34)	37	154	(95)	13	87	(115)	5	77	(42)	76
14.00	80	(37)	46	82	(40)	30	51	(38)	34	160	(85)	11	60	(41)	3	78	(43)	67
15.00	72	(33)	20	67	(30)	10	48	(37)	23	179	(107)	5	43	(14)	1	67	(52)	39
16.00	70	(32)	13	77	(47)	7	46	(34)	30	157	(71)	4	26	(11)	1	60	(40)	40
17.00	77	(42)	16	79	(44)	10	48	(38)	24	161	(79)	8	48	(29)	1	71	(50)	37
18.00	74	(36)	36	85	(50)	29	50	(38)	33	193	(107)	30	66	(46)	1	87	(60)	65
19.00	76	(34)	38	91	(51)	26	55	(49)	32	210	(92)	36	58	(46)	1	93	(67)	67
20.00	71	(33)	22	82	(44)	18	51	(48)	27	211	(120)	16	77	(61)	2	85	(70)	49
21.00	69	(35)	18	83	(48)	13	46	(34)	26	218	(111)	13	56	(33)	2	76	(64)	43
22.00	67	(32)	23	67	(38)	11	44	(31)	34	188	(93)	4	51	(38)	4	61	(47)	50
23.00	56	(25)	14	66	(38)	7	46	(32)	21	224	(101)	2	45	(28)	4	60	(47)	34
24.00	70	(32)	9	66	(33)	4	47	(33)	9	190	(118)	1	39	(12)	2	61	(41)	17

	Full-fat milk			Reduced-fat milk			Cheese			Yoghurt			Total dairy		
	Mean	(SD)	% Cons	Mean	(SD)	% Cons	Mean	(SD)	% Cons	Mean	(SD)	% Cons	Mean	(SD)	% Cons
07.00	80	(57)	21	74	(43)	21	35	(25)	2	89	(31)	1	77	(54)	24
08.00	72	(47)	46	73	(43)	54	34	(28)	4	117	(52)	6	72	(45)	56
09.00	69	(47)	54	73	(43)	55	32	(20)	5	104	(38)	7	70	(44)	64
10.00	65	(67)	59	76	(64)	54	41	(30)	10	115	(34)	9	66	(60)	68
11.00	60	(57)	60	63	(57)	55	38	(23)	11	131	(27)	8	61	(50)	67
12.00	61	(63)	44	56	(49)	33	31	(13)	8	152	(85)	8	61	(54)	51
13.00	72	(74)	66	61	(58)	58	39	(24)	41	124	(35)	31	66	(58)	79
14.00	79	(114)	60	64	(75)	49	38	(22)	33	123	(33)	20	71	(93)	74
15.00	71	(82)	39	64	(86)	29	37	(24)	12	123	(33)	7	67	(74)	46
16.00	61	(79)	43	69	(93)	35	33	(16)	7	123	(44)	10	63	(74)	51
17.00	70	(81)	39	72	(86)	31	34	(27)	8	110	(37)	10	69	(77)	48
18.00	79	(87)	58	76	(80)	54	36	(21)	21	120	(38)	17	76	(76)	73
19.00	81	(88)	57	72	(70)	53	35	(20)	23	136	(38)	20	78	(76)	72
20.00	70	(88)	41	81	(106)	35	36	(23)	14	121	(44)	12	71	(84)	52
21.00	66	(87)	41	54	(46)	36	38	(29)	12	131	(48)	11	65	(75)	52
22.00	66	(74)	44	58	(59)	38	33	(28)	14	137	(36)	8	63	(66)	55
23.00	62	(65)	29	77	(94)	29	36	(24)	7	118	(35)	5	65	(70)	37
24.00	73	(79)	16	84	(98)	15	31	(15)	4	141	(44)	3	74	(80)	20

SD – standard deviation.

tertile. However, low fibre consumers tended to have a slightly later morning peak for consumption of wholemeal bread, breakfast cereals, total cereals, reduced-fat milk and total dairy than medium and high consumers. Intakes of breakfast cereals and yoghurt by tertiles of intake, fat and fibre are presented in Fig. 1 to demonstrate how the same mealtime patterns emerge when the number of consumers is controlled for. Even when the patterns vary slightly over the course of the day according to different tertiles (e.g. yoghurt), the same basic mealtime patterns (e.g. main peak at lunch with slight peak at late morning and evening) can be seen for each tertile.

Discussion

FBDG need to be based on prevailing dietary patterns and must account for the socio- economic and cultural factors of the country for which they are being developed[1]. The cultural context of food consumption should include, among other factors, the time at which foods are consumed, that is the temporal distribution of food intake[3]. A temporal analysis of food intakes is potentially important in understanding patterns of food consumption and could therefore be very important for the development of effective FBDG.

The present temporal analysis of food intakes includes analysis of day of the week and time of the day at which foods were consumed. Examining food intakes over time of the day is a novel method of analysis, which also avoids between-subject variation that might be found if food intake were examined based on meal occasion. As there is no scientific definition of meal occasion, it was self-defined by the respondents in the present study and so assessing food intakes by time of day was deemed a more

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Table 3 Cereal and dairy products consumed at each hour as a percentage of the total consumed

	White bread	Wholemeal bread	Cakes	Rice & pasta	Breakfast cereals	Total cereals	Full-fat milk	Reduced-fat milk	Cheese	Yoghurt	Total dairy
07.00	2.2	3.0	0.3	0.0	8.9	2.8	3.7	4.4	0.8	0.4	3.4
08.00	5.9	9.6	1.1	0.0	32.2	9.4	9.5	13.6	2.3	2.4	9.3
09.00	6.8	11.9	1.6	0.0	27.5	9.5	9.6	11.6	1.9	3.7	9.1
10.00	9.1	9.7	5.5	0.0	14.7	8.4	7.8	9.3	6.0	5.1	7.7
11.00	7.0	5.7	9.2	0.0	6.8	6.2	6.3	5.8	5.1	5.1	5.9
12.00	4.1	3.6	4.8	0.7	2.3	3.4	4.0	2.8	2.8	4.0	3.7
13.00	16.3	14.1	10.7	6.9	1.7	11.2	9.8	8.0	21.7	22.5	10.7
14.00	11.0	7.7	8.2	5.8	0.5	7.6	7.5	4.9	14.1	9.8	7.7
15.00	3.3	1.8	4.6	2.4	0.2	2.6	3.1	2.4	4.3	3.0	3.1
16.00	2.1	1.2	6.2	2.0	0.1	2.3	3.4	3.1	2.0	4.1	3.4
17.00	2.6	2.1	5.2	4.2	0.2	2.8	3.6	3.8	2.6	3.4	3.7
18.00	7.2	9.5	8.5	22.8	0.2	8.4	7.9	8.5	8.0	8.6	8.2
19.00	7.8	7.8	8.2	28.9	0.2	9.0	7.6	6.9	8.7	9.9	7.8
20.00	3.4	3.9	5.8	11.7	0.4	4.7	3.3	3.5	5.6	5.2	3.7
21.00	2.6	3.5	5.5	9.2	0.4	3.8	3.4	2.9	4.7	4.8	3.5
22.00	3.6	2.1	7.1	2.7	0.8	3.5	3.7	3.2	4.3	3.7	3.7
23.00	1.9	1.2	4.5	1.6	0.6	2.1	2.2	2.9	2.2	2.0	2.3
24.00	1.3	0.7	1.8	0.6	0.3	1.0	1.5	1.3	1.1	1.1	1.4

precise method of analysis. A number of studies were found in the literature which examine the temporal distribution of nutrients[4,5]. Three studies were found that present information on food intake for day of the week, only one of which presents data for an adult population[8]. Of the two other studies, one was based on an elderly population[6] and one was based on 10-year-old children[7] where data were presented as the percentage contribution of foods to energy and not as absolute food intakes. Moreover, these studies examined large aggregated food groups, which makes comparisons with the present study very difficult. The focus of these studies was not to present detailed results that could be used in the development of FBDG, but rather to conclude that weekend days need to be included in food consumptions surveys to characterise food consumption patterns accurately.

Many methodological issues arise when examining the temporal distribution of food groups; however, this is not reported in the majority of published papers. The first issue in temporal analysis is whether mean intakes should be examined for the total population or for consumers of the food group. Mean intakes for the total population could include a large number of zero values at certain time points, which would lower the overall mean intakes and therefore not give a true representation of intakes for those who consume the foods. In the present study, it was decided to examine both percentage of consumers of the target foods and mean intakes for consumers only, given that – for temporal analysis or FBDG – interest lies only with those who consume the foods.

Many different calculation methods can be used when analysing the temporal distribution of foods and should be taken into account when making comparisons with other peer-reviewed papers. However, most publications do not give detailed accounts of how mean intakes were calculated. In the present study, calculation of the mean intakes over day of the week was performed by summing the amount of each food group consumed every day by each respondent, and then computing the mean per weekday for these consumers. This allowed comparison of the amount of the food groups consumed on one day with the amount consumed on any other day of the week. However, when calculating mean intakes over time of the day, a different approach was used. Intakes per hour were assessed by calculating the mean amount of each food group consumed by each respondent at the hour and then computing the mean per hour for these consumers. This method calculated the average amount of the food group consumed at that hour over the course of the week, regardless of the day. For example, if a person consumed 70 g of white bread at 13.00 hours every day for 5 days, calculating the mean per respondent and then the mean for the population tells us that the average amount consumed by that respondent is 70 g. This method was used so that the amount consumed per hour reflected the average amount consumed at the hour regardless of the day, and did not show the total amount of the food group consumed at that hour over the course of the week. Mean food group intakes over hour of the day were confounded by small numbers of consumers at certain hours, which tended to skew the data. Additional analyses were carried out to try to control for this confounding factor. The amount of the food group consumed at each hour was expressed as a percentage of the total food group consumed over the week, which gave a more realistic pattern of consumption over the course of the day and showed either a definite mealtime or snacking pattern for all food groups.

One of the major methodological issues with the present study was statistical analysis. It was deemed inappropriate to carry out statistical analysis on mean intakes over the hour. Statistical analysis of 11 different food groups over 18 hours would involve too many combinations to find a meaningful statistical significance.

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Table 4 Mean intake of cereal products (g) over day of the week by tertile of intake

	White bread*									Wholemeal bread									Cakes								
	Low cons			Medium cons			High cons			Low cons			Medium cons			High cons			Low cons			Medium cons			High cons		
	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)
Monday	69	180	(38)	104	224	(49)	166	248	(88)	65	105	(29)	99	158	(44)	172	148	(93)	35	139	(24)	64	172	(39)	126	184	(85)
Tuesday	67	165	(37)	103	217	(47)	171	246	(97)	64	113	(29)	94	144	(39)	181	168	(98)	38	139	(26)	66	182	(38)	123	204	(83)
Wednesday	67	187	(32)	106	216	(51)	176	237	(95)	62	108	(27)	99	142	(48)	189	147	(117)	40	137	(27)	70	190	(38)	122	199	(69)
Thursday	69	192	(37)	108	239	(55)	172	257	(84)	58	101	(28)	103	147	(42)	184	155	(94)	36	151	(22)	68	189	(38)	123	192	(72)
Friday	67	188	(35)	106	229	(54)	176	244	(94)	60	105	(28)	97	147	(44)	189	161	(117)	38	142	(25)	66	170	(37)	121	180	(84)
Saturday	64	200	(33)	101	234	(53)	157	247	(77)	56	88	(26)	99	133	(44)	179	153	(103)	37	121	(25)	77	140	(45)	124	178	(87)
Sunday	67	174	(38)	90	213	(44)	132	227	(72)	60	107	(28)	92	137	(43)	174	150	(102)	36	125	(24)	62	159	(38)	115	165	(75)

	Rice & pasta									Breakfast cereals									Total cereals*								
	Low cons			Medium cons			High cons			Low cons			Medium cons			High cons			Low cons			Medium cons			High cons		
	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)
Monday	99	34	(43)	187	41	(46)	322	29	(120)	30	142	(8)	51	167	(19)	154	185	(118)	146	311	(79)	223	317	(98)	372	319	(174)
Tuesday	118	40	(62)	188	47	(44)	301	42	(121)	29	136	(8)	49	158	(14)	151	186	(106)	148	308	(78)	238	319	(112)	390	318	(174)
Wednesday	120	30	(59)	204	34	(52)	285	33	(131)	29	149	(8)	50	162	(21)	155	187	(114)	152	312	(90)	238	316	(110)	376	318	(181)
Thursday	119	26	(53)	179	29	(40)	231	29	(81)	30	153	(8)	47	148	(16)	153	193	(113)	151	310	(72)	238	317	(102)	376	318	(185)
Friday	91	34	(49)	185	37	(50)	286	37	(113)	30	140	(9)	47	150	(16)	150	184	(100)	149	308	(81)	245	317	(118)	377	318	(181)
Saturday	115	30	(57)	185	32	(48)	300	33	(127)	30	135	(7)	50	140	(17)	136	164	(105)	139	313	(83)	234	311	(112)	351	315	(186)
Sunday	110	14	(64)	185	32	(38)	321	19	(118)	30	121	(7)	50	119	(18)	127	140	(95)	122	298	(72)	194	312	(101)	300	313	(157)

cons – consumer; SD – standard deviation.
* Significant combined effect of day and tertile using three-way analysis of variance.

Table 5 Mean intake of dairy products (g) over day of the week by tertile of intake

	Full-fat milk*									Reduced-fat milk									Cheese								
	Low cons			Medium cons			High cons			Low cons			Medium cons			High cons			Low cons			Medium cons			High cons		
	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)
Monday	83	188	(67)	209	259	(114)	427	277	(223)	94	73	(57)	183	96	(70)	370	91	(162)	23	72	(10)	40	99	(17)	70	97	(52)
Tuesday	75	196	(58)	195	263	(99)	448	278	(249)	92	74	(57)	182	91	(68)	355	93	(175)	23	82	(11)	38	93	(13)	65	103	(35)
Wednesday	81	186	(59)	207	267	(112)	436	280	(267)	93	78	(62)	186	92	(88)	387	93	(197)	23	84	(11)	38	89	(16)	66	105	(39)
Thursday	76	193	(58)	197	264	(94)	449	275	(254)	84	76	(44)	170	89	(69)	387	90	(211)	22	77	(10)	36	104	(16)	68	117	(41)
Friday	71	203	(51)	183	265	(102)	436	279	(292)	76	80	(47)	179	90	(89)	340	95	(208)	24	97	(11)	37	98	(14)	67	114	(32)
Saturday	70	180	(52)	182	253	(118)	386	273	(243)	82	68	(54)	179	88	(73)	343	87	(168)	22	73	(11)	39	92	(14)	65	100	(44)
Sunday	74	171	(67)	172	252	(100)	349	269	(211)	87	66	(50)	174	93	(91)	323	93	(155)	21	82	(10)	35	70	(16)	63	71	(37)

	Yoghurt									Total dairy*								
	Low cons			Medium cons			High cons			Low cons			Medium cons			High cons		
	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)	Mean	*n*	(SD)
Monday	92	25	(38)	125	68	(2)	181	40	(76)	131	286	(83)	274	315	(126)	498	318	(217)
Tuesday	102	26	(31)	127	50	(16)	181	44	(78)	127	281	(80)	261	318	(111)	519	319	(241)
Wednesday	103	28	(34)	125	53	(3)	192	37	(92)	133	291	(86)	273	319	(120)	516	317	(268)
Thursday	93	30	(41)	125	57	(1)	181	33	(68)	120	294	(74)	261	315	(117)	519	318	(251)
Friday	105	23	(36)	125	61	(10)	183	29	(80)	120	286	(75)	254	315	(115)	504	318	(292)
Saturday	90	22	(37)	125	33	(2)	190	32	(91)	111	287	(78)	237	312	(120)	449	319	(237)
Sunday	93	21	(44)	125	29	(1)	172	18	(79)	117	283	(79)	225	316	(111)	420	315	(218)

cons – consumer; SD – standard deviation.
* Significant combined effect of day and tertile using three-way analysis of variance.

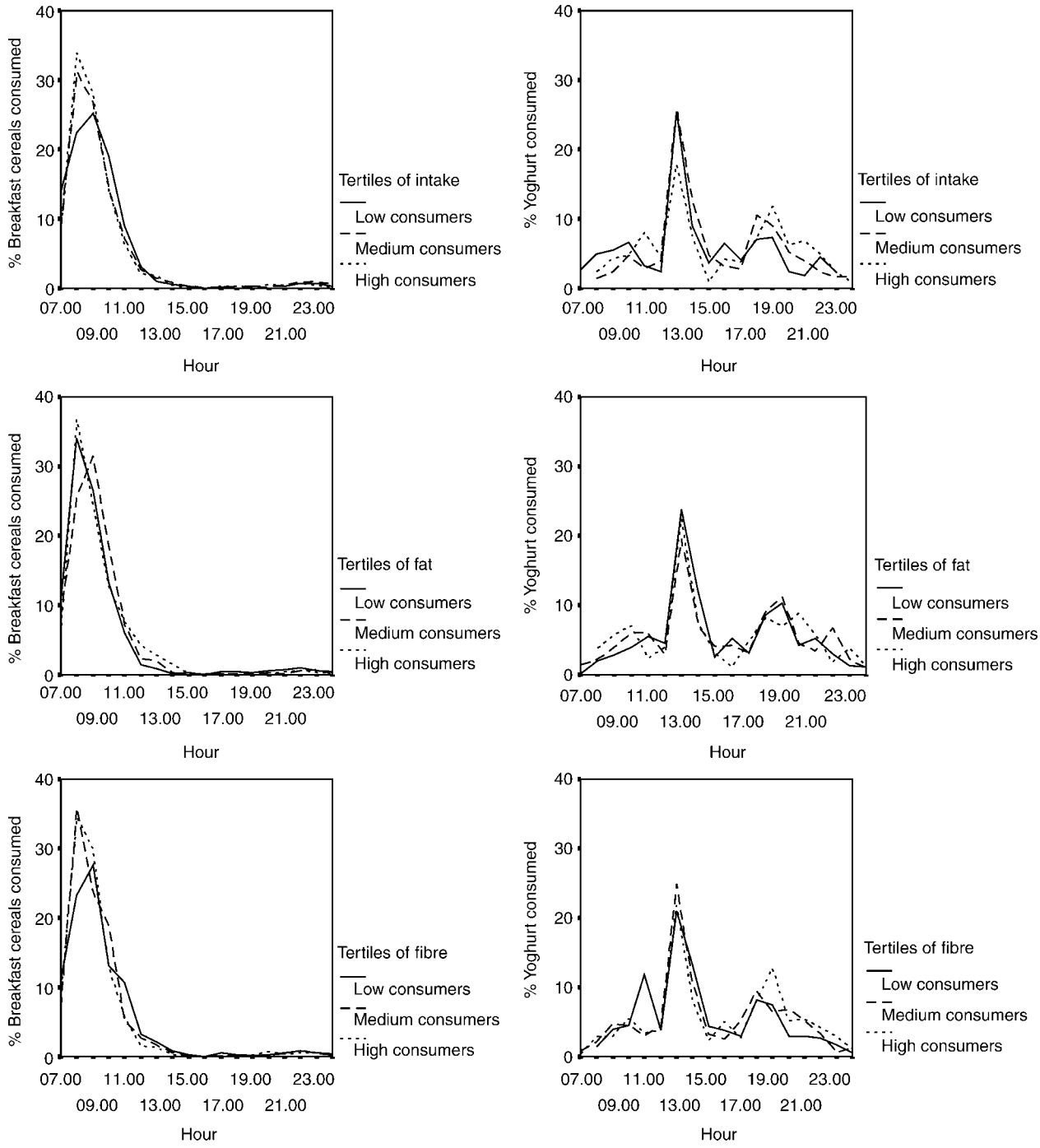

Fig. 1 Intake of breakfast cereals and yoghurt at each hour as a percentage of the total consumed for tertiles of intake, tertiles of fat intake and tertiles of fibre intake

Statistical analysis could not be carried out on food groups consumed at each hour. This was because the most meaningful comparisons involved expressing the amount of the target food consumed at the hour as a percentage of the total consumed, which generated one value at each hour as opposed to a range of values. For the present study, trends were deemed more important than statistically significant differences.

Maisey *et al.*[6] and Jula *et al.*[8] reported little variation in intakes of cereals and dairy products over day of the week. These results support the findings of the present study. Although intakes of total cereal products and total dairy products were found to be significantly lower at the weekends, the largest difference was 53 g for cereals and 50 g for dairy products, which is not a substantial amount in terms of establishing FBDG. For example, 50 g of total dairy products or total cereal products contributes to approximately 2.4 g and 2.5 g of fat respectively in Irish adults, which is not a considerable amount relative to achieving fat guidelines. Intakes of full-fat milk and white

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bread were also significantly lower at the weekend, but not by a large amount. In the present study, intakes of cereal and dairy products over time of the day (when controlled for the numbers of consumers) showed clear mealtime or snacking patterns, but do not show anything different to what would be expected. Temporal analysis on the intakes of cereal and dairy products by tertile of intake, tertile of percentage energy from fat and tertile of fibre intake (per MJ) did not show radical differences between low, medium and high consumers of the foods or nutrients, and showed little variation across day of the week and time of the day.

Food intake data are generally presented as mean intakes; however, a lot of important information relating to food consumption patterns can be lost this way. This problem could be minimised by presenting intakes over day of the week or time of the day. Temporal analysis of food intakes could be extremely useful in the development of FBDG, and the need for such has been highlighted in the reports of the Eurodiet project[3]. Data presented in this paper could be used when developing FBDG. For example, the intake of dairy products does not vary much over the course of the week so policies to increase dairy product consumption in order to increase calcium intakes would be very general and not call for increased intakes on any particular day of the week. However, policies to increase fibre intakes could be more specific. Breakfast cereals are a good source of fibre[11] and so increased breakfast cereal consumption could be promoted to increase fibre intake. These messages could be targeted later in the day as breakfast cereals are primarily consumed in the morning.

In conclusion, whereas temporal analysis of the distribution of food intake seemed an attractive possibility in deriving FBDG, the present study, which focused on cereal and dairy intake, did not reveal a considerable amount of useful data in this respect. The study has revealed the difficult methodological and statistical issues in temporal distribution studies that have not been addressed in the limited literature available. However, analysis of the intakes of other food groups might prove useful before discarding the idea of temporal patterns of food intake for use in deriving FBDG.

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