The Kilkenny Health Project: food and nutrient intakes in randomly selected healthy adults

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(*Received 5 April 1988 – Accepted 9 November 1988*)

1. Sixty healthy subjects aged 35–44 years (thirty men and thirty women) were randomly selected from electoral registers to participate in a dietary survey using the 7 d weighed-intake method during June–August 1985.

2. Energy intake (MJ/d) was 12·5 for men and 8·4 for women. Fat contributed 36·0 and 39·1 % of the total energy intake of men and women respectively. When this was adjusted to exclude energy derived from alcoholic beverages, the corresponding values were 38·8 and 39·7 % respectively. The major sources of dietary fat (%) were spreadable fats (28), meat (23), milk (12) and biscuits and cakes (11).

3. The subjects were divided into low- and high-fat groups both on the relative intake of fat (< 35 % or > 40 % dietary energy from fat) and on the absolute intake of fat (> or < 120 g fat/d). By either criterion, high-fat consumers had lower than average intakes of low-fat, high-carbohydrate foods such as potatoes, bread, fruit and table sugar, and higher intakes of milk, butter and confectionery products. Meat intake was higher among high-fat eaters only when a high-fat diet was defined as a percentage of energy.

The Kilkenny Health Project is a community health programme which aims to alter the environment and behaviour of a defined population in order to modify risk factors for coronary heart disease. The 5-year programme began in 1985 with a baseline survey of 770 adults aged 35–64 years. The purpose of this survey was to estimate the knowledge, attitudes and behaviour relevant to the development of coronary heart disease and to measure the baseline levels of risk factors for this disease. While the baseline survey included a food-frequency questionnaire, it was felt that a more comprehensive analysis of eating habits was required from which a strategy for nutrition education could be developed. Accordingly, thirty males and thirty females in the age range 35–44 years were randomly selected to participate in a 7 d weighed-intake study of eating habits. This survey constitutes the basis of the present paper.

SUBJECTS AND METHODS

Sixty subjects (thirty male and thirty female) were randomly selected from a group of 332 individuals aged 35–44 years, which itself was randomly selected from the electoral register. The sixty subjects agreed to participate in a dietary survey which took place before the subjects were evaluated in the baseline survey. The dietary survey took place between June and August 1985. During the study two subjects withdrew and were replaced by two others from a reserve list. The dietary survey was carried out using the 7 d weighed-intake method. On the day before the period of study each subject was visited by a dietitian who explained

Table 1. *Serum cholesterol, blood pressure, age and anthropometric values: a comparison of the samples in the dietary survey and the baseline survey of a randomly selected group of Kilkenny adults**

(Mean values and standard deviations)

Survey...	Dietary				Baseline			
n...	Men 30		Women 30		Men 175		Women 157	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Serum cholesterol (mmol/l)	6·1	1·1	5·6	1·2	5·9	0·9	5·4	1·0
Blood pressure (mmHg):								
Diastolic	73	12	73	12	74	12	71	10
Systolic	138	11	127	13	136	13	126	13
Weight (kg; W)	82	11	66	11	79	11	65	11
Height (m; Ht)	1·75	0·05	1·65	0·05	1·75	0·06	1·62	0·06
Body mass index (W/Ht^2)	28·7	2·6	24·3	3·2	25·9	3·2	24·7	3·8
Age (years)	39	3	39	3	40	3	39	3

* For details of surveys, see p. 129.

Table 2. *Energy and selected nutrient intakes (/d) of a randomly selected group of Kilkenny adults*

(Mean values and standard deviations)

	Men (*n* 30)		Women (*n* 30)	
	Mean	SD	Mean	SD
Energy (MJ)	12·5	2·6	8·4	2·2
Protein (g)	107	22	77	22
Fat (g)	119	35	87	28
Total carbohydrate (g)	344	88	232	67
Starch (g)	180	54	130	38
Lactose (g)	19	12	13	9
Sugars (excluding lactose) (g)	129	57	82	41
Ethanol (g)	27	40	4	9
Dietary fibre (g)	24	6	20	9
Calcium (mg)	1026	364	761	252
Iron (mg)	15·8	6·5	11·8	4·2
Vitamin A (mg)	1180	666	1022	1148
Riboflavin (mg)	2·4	0·7	1·7	0·7
Nicotinic acid (mg)	28·1	6·4	20·2	7·3
Ascorbic acid (mg)	89	26	73	32

the use of the diet scales (Salter, 0–900 g × 5 g) and the diet record book. Each subject was contacted either personally or by telephone mid-way through the study period and each was re-visited at the end of the 7 d study. During this final visit the diet record book was carefully checked to ensure accuracy and clarity of the records of food eaten and of plate waste.

The information collected was coded according to McCance and Widdowson's tables of food composition (Paul & Southgate, 1978) and nutrient intakes were computed using the

Table 3. *Energy distribution* (%) *in the diets of a randomly selected group of Kilkenny adults, including alcoholic beverages and excluding alcoholic beverages*

(Mean values and standard deviations)

	Men (*n* 30)		Women (*n* 30)	
	Mean	SD	Mean	SD
Including alcoholic beverages				
Protein	14·7	2·7	15·6	3·4
Fat	36·0	7·1	39·1	4·8
Total carbohydrate	43·3	6·9	43·8	5·7
Sugars (excluding lactose)	17·2	6·5	16·0	6·7
Excluding alcoholic beverages				
Protein	16·0	2·6	15·9	3·4
Fat	38·8	6·30	39·7	4·9
Total carbohydrate	45·7	7·80	44·2	5·9

Table 4. *Sources* (%) *of dietary fat in a randomly selected group of Kilkenny adults*

(Mean values and standard deviations)

	Men (*n* 30)		Women (*n* 30)	
	Mean	SD	Mean	SD
Fresh meat	17·4	9·0	16·6	7·9
Processed meat	6·8	7·3	4·7	3·8
Butter	21·3	14·8	16·0	14·8
Margarine	5·6	11·6	12·7	14·3
Milk	12·6	7·1	12·3	8·4
Eggs	4·6	3·6	5·4	3·5
Cheese	2·5	4·0	2·9	3·3
Biscuits and cakes	11·0	8·3	11·4	7·7
Sweets and chocolates	1·2	2·3	2·5	2·8
Potatoes (fried or roasted)	3·3	3·2	1·8	1·9
Other vegetables (fried or roasted)	2·2	3·9	0·9	1·8
Bread	4·0	1·8	4·3	2·3
Ice-cream, cream or yoghurts	1·5	1·9	2·3	2·7
Sauces	1·6	3·2	1·6	2·2

Microdiet program of these same tables (Bassham & Fletcher, 1985). Each subject participated in the subsequent baseline survey. Height was measured using a 2 m rule taped vertically to a wall, and weight was recorded using a set of digital weighing scales (SECA 708). Blood pressure was recorded twice using a Hawksley Random Zero sphygomomanometer. The systolic and fifth-phase diastolic blood pressures were recorded and the mean of the first and second readings was used. A sample of venous blood was taken for serum cholesterol measurement by an enzymic colorimetric method using an assay kit (Boehringer, Mannheim).

RESULTS

The results in Table 1 show that the sub-sample who participated in the dietary survey were generally comparable to the total sample of subjects aged 35–44 years who participated in

Table 5. *Mean daily intakes of nutrients and foods and the distribution of dietary energy of a randomly selected group of Kilkenny adults consuming either low-fat (< 35 % energy) or high-fat (> 40% energy) diets**

(Mean values and standard deviations)

	Men				Women			
Dietary fat (% energy)...	<35		>40		<35		>40	
n...	8		11		6		12	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Nutrients								
Energy (MJ)	11·4	1·8	11·6	3·0	7·0	2·0	9·0	2·3
Protein (g)	104	21	109	23	66	18	84	27
Fat (g)	99	20	138	42	64	19	107	26
Total carbohydrate (g)	374	58	282	92	223	61	229	66
Starch (g)	193	48	164	52	136	48	130	38
Sugars, excluding lactose (g)	146	50	88	42	74	33	76	30
Dietary fibre (g)	23·9	6·0	23·6	6·5	23·0	11·3	21·3	9·9
Energy distribution								
Protein energy (%)	15·3	2·5	16·4	2·8	15·6	1·1	15·5	2·5
Fat energy (%)	32·7	1·7	44·8	5·7	33·8	1·0	44·7	3·5
Carbohydrate energy (%)	52·0	3·0	38·7	6·1	50·6	1·6	39·8	4·8
Foods								
Butter (g)	16	18	34	32	6	11	30	22
Margarine (g)	23	24	12	23	24	9	11	13
Fresh meat (g)	118	61	164	103	67	36	113	58
Processed meat (g)	50	39	39	31	17	8	23	21
Milk (g)	258	175	362	294	192	76	292	211
Eggs (g)	21	10	48	33	38	31	38	12
Potatoes (g)	393	21	217	83	174	74	148	70
Other vegetables (g)	185	124	192	115	153	76	133	44
Bread (g)	232	83	190	80	191	92	148	82
Table sugar (g)	78	51	12	18	13	20	20	24
Fruit (g)	56	54	92	79	64	55	82	69
Biscuits and cakes (g)	47	36	70	54	20	11	62	37
Sweets and chocolates (g)	17	40	7	14	7	7	9	8

* Alcoholic beverages are excluded from the calculations.

the baseline survey. The notable exception was the higher body mass index of the males in the sub-sample. This can only be explained on the basis of the chance effects of sampling. The intakes of energy, macronutrients and selected micronutrients are given in Table 2. The energy intake of men was approximately 50% higher than that of women and consequently the relative intakes of most other nutrients reflect this differential. The distribution of energy is given in Table 3. When alcohol was included in the calculations, fat provided less energy for men than women (36·0 *v.* 39·1 %). However, when alcohol intake was excluded these differences largely disappear (38·8 *v.* 39·7). The sources of dietary fat are given in Table 4. The main sources of dietary fat (%) were butter/margarine (28), meats (23), milk (12) and biscuits and cakes (11).

The results in Table 5 describe the dietary patterns of thirty-seven of the sixty subjects. Eleven men and twelve women were classified as 'high-fat eaters' because fat contributed more than 40% of energy (alcohol beverages excluded). Eight men and six women were classified as being 'low-fat eaters' on the basis that fat contributed less than 35% of dietary

Table 6. *Daily intakes of nutrients and foods and the distribution of dietary energy in a randomly selected group of Kilkenny men with dietary fat intakes either below or above 120 g/d**

(Mean values and standard deviations)

Dietary fat (g/d)...	< 120		> 120	
n...	15		15	
	Mean	SD	Mean	SD
Nutrients				
Energy (MJ)	9·6	2·7	13·4	1·4
Protein (g)	94	20	121	15
Fat (g)	91	14	148	23
Total carbohydrate (g)	295	77	363	82
Starch (g)	208	49	152	42
Sugars, excluding lactose (g)	120	51	111	55
Dietary fibre (g)	26·0	6·1	22·2	5·2
Energy distribution				
Protein energy (%)	16·4	2·8	15·6	2·4
Fat energy (%)	36·0	3·9	41·6	6·4
Carbohydrate energy (%)	47·6	5·8	42·8	7·3
Foods				
Butter (g)	18	17	48	26
Margarine (g)	11	17	8	21
Fresh meat (g)	129	58	166	85
Processed meat (g)	38	35	54	51
Milk (g)	308	172	486	293
Eggs (g)	23	23	52	36
Potatoes (g)	256	68	276	122
Other vegetables (g)	163	96	167	60
Bread (g)	170	74	238	82
Table sugar (g)	53	56	45	43
Fruit (g)	67	72	60	55
Biscuits and cakes (g)	44	36	80	48
Sweets and chocolates (g)	2	4	6	12

* Alcoholic beverages are excluded from the calculations.

energy (alcohol beverages excluded). The pattern of daily food consumption in these two groups is given in Table 5. When the intakes of foods were compared for these groups, it became evident that when both sexes were considered together, the low-fat eaters were clearly distinguished from the high-fat eaters by their higher intakes of bread, potatoes and margarine and their lower intakes of butter, total spreadable fats, milk, fruit and biscuits and cakes. Male low-fat eaters were further distinguished from male high-fat eaters by their markedly higher intakes of table sugar and their lower intakes of eggs.

The relation between fat intake and energy intake (excluding alcoholic beverages) is given in Fig. 1. In the case of females, energy intake (MJ/d) was linearly related to fat intake (g/d) according to the linear regression equation: energy intake = 0·073 fat intake + 1·89 (SD 0·006, t 12·8, $P < 0·001$; $r + 0·92$, $P < 0·001$). In the case of males, energy intake was not linearly related to fat intake but was best described by the linear regression of energy intake MJ/d *v.* $\log_{10}$ fat intake (g/d) according to the equation: energy intake = 36·8 $\log_{10}$ fat intake − 64·3 (SD 1·79, t 20·4, $P < 0·001$; $r + 0·88$, $P < 0·001$). Thus, in males, energy intake increased with increasing fat intake up to about 120 g fat/d, above which the rate of increase in fat intake with increasing energy intake became less steep.

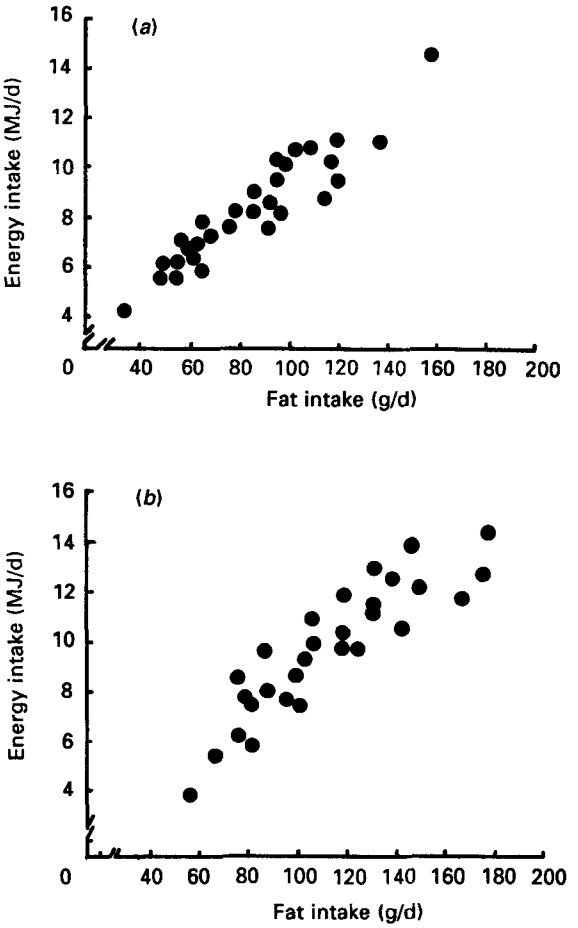

Fig. 1. The relation between energy intake (MJ/d) and fat intake (g/d) in a randomly selected group of healthy Kilkenny adults: (*a*) females, (*b*) males.

Table 6 compares nutrient and food intakes of men with fat intakes > 120 g/d or < 120 g/d. The mean fat intakes of the two groups were 91 and 148 g/d respectively. This differential in fat intake was proportionately greater than the differentials in either protein intakes (94 *v.* 121 g) or carbohydrate intakes (295 *v.* 363 g). Thus 59% of the differential in energy intakes between these groups was due to the differential in fat intake with protein and carbohydrate accounting for 12 and 29% respectively of the differential. These differences were reflected in the patterns of food consumption of the two groups, with the high-fat-intake group having higher mean daily intakes of butter, meat, milk, eggs and biscuits and cakes. While the higher energy intake of this group was reflected in a higher consumption of bread, their intakes of other low-fat foods did not generally reflect this higher energy intake, i.e. potatoes, table sugar, vegetables and fruit.

DISCUSSION

Estimates of nutrient intakes in Ireland are largely limited to indirect estimates using information on household expenditure (Cremin & Morrissey, 1976; Upton & Gibney,

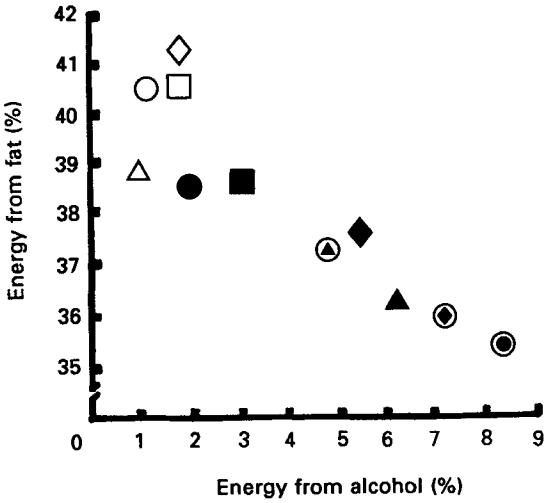

Fig. 2. The relation between dietary energy (%) derived from fat and alcohol in recent dietary surveys in Britain and Ireland. The values of Bingham *et al.* (1981) and Cade *et al.* (1988) are estimates from published values. Cambridgeshire: (○), females; (●), males (from Bingham *et al.* 1981); Cambridgeshire: (□), females; (■), males (Nelson, 1985); Kilkenny: (△), females; (▲), males (present study); South Wales: (◇), females (Barasi *et al.* 1985); South Wales: (◆), males (Fehilly *et al.* 1984); Ipswich: (◬), males and females; Wakefield: (◈), males and females; Stoke: (◉), males and females (from Cade *et al.* 1988).

1977; Gibney & Upton, 1978; Robertson & Kevany, 1982; Upton & Gibney, 1987). Findings from the present study would suggest that the mean contribution of fat to dietary energy (37·6%) is midway between the recommended value of 35% (National Advisory Committee on Nutrition Education, 1983; Department of Health and Social Security, 1984; Food Advisory Committee, 1984) and the value of 40% frequently quoted for the UK. It is, however, lower than the mean value of 39·7% reported for Cambridgeshire adults in two independent studies (Bingham *et al.* 1981; Nelson, 1985).

Recent preliminary findings would suggest that Cambridgeshire may be unrepresentative of the UK as a whole (Cade *et al.* 1988). Indirect estimates of the contributions of dietary fat to energy intakes in Ipswich, Wakefield and Stoke were 37·0, 36·0 and 35·6% respectively. Given that the recommended short-term target for dietary fat energy is 35%, it would appear that, at first sight, some regions are achieving this target while others are not. Equally from the present study, and from those of Nelson (1985) and Bingham *et al.* (1981), men appear to be more likely to achieve this target than women. These differences between regions may reflect methodological differences but are more likely to be due to the contribution which alcohol makes to energy, as can be seen in Fig. 2. Regions with high-fat-energy intakes tend to have low alcohol intakes and vice versa. Thus while alcohol may be included in deriving nutritional targets for populations, comparisons of findings from different dietary surveys should ideally exclude the diluting effect of the energy of alcoholic beverages on fat intakes. In the present paper, comparisons of food intakes in groups achieving and not achieving a target of 35% dietary fat energy and of men with intakes above and between 120 g fat/d are therefore made exclusive of intakes of alcoholic beverages.

Nelson (1985) compared the intakes of foods in two groups in which fat contributed either less than or more than 35% of dietary energy. A minimum value of 20 g/d for dietary fibre intake and a maximum value of 10% of dietary energy from alcohol was applied to

both groups. This division of subjects yielded some unexpected results, in that the two groups could not be clearly distinguished by their intakes of such high-fat foods as meat and meat dishes, spreadable fats, milk and chips. In contrast, a striking difference was observed in the sugar consumption of the two groups with the low-fat group consuming considerably more sugar than the high-fat group. A similar observation was made for sugar consumption by men in the present study. However, in contrast to the findings of Nelson (1985), the more extreme division of subjects into those with $< 35\%$ or $> 40\%$ of energy from dietary fat, and excluding alcoholic beverages, did reveal other differences in food-consumption patterns. Groups with lower fat-energy intakes had slightly lower intakes of spreadable fats. Butter consumption was lower and margarine consumption was higher for both men and women with low-fat-energy intakes. For both sexes, the intakes of meat, milk, biscuits and cakes and sweets and chocolates were lower in the groups consuming $< 35\%$ of energy from fat and the intakes of bread and potatoes, fruit and table sugar were higher in this group. These findings would therefore suggest that individuals who achieve an intake of $< 35\%$ of dietary energy from fat have lower intakes of butter, milk and meat and higher intakes of bread, potatoes, fruit and table sugar.

This pattern of a higher consumption of carbohydrate-rich foods and a lower consumption of fat-rich foods in individuals consuming $< 35\%$ of dietary energy from fat is partly an artifact of expressing fat intakes as a percentage of dietary energy. Thus the same groups would have been chosen if the criteria for selection had been $> 50\%$ and $< 40\%$ of energy from dietary carbohydrate. An alternative approach is to select an absolute intake of fat above and below which comparisons are made. Thus, by dividing the group of thirty men into those with fat intakes above (n 15) or below (n 15) 120 g/d, it is possible to compare groups with high and low absolute intakes of fat without the diluting effect of carbohydrates that inevitably follows from expressing fat intake relative to energy. However, since energy intake is no longer controlled, the group with the higher intake of dietary fat, also had a higher energy intake. Any comparison of intakes of foods in the two groups should take account of this difference in energy intake. Thus, daily butter consumption was 1·9 g/MJ in the low-fat group and 3·6 g/MJ in the high-fat group. In contrast, bread consumption was similar for the two groups (18 g/MJ per d) as was meat consumption (12 g/MJ per d). The high-fat group had a marginally higher intake of milk (36 *v.* 32 g/MJ per d), biscuits and cakes (6·0 *v.* 4·6 g/MJ per d) and eggs (3·9 *v.* 2·4 g/MJ per d) and lower intakes of potatoes (21 *v.* 27 g/MJ per d), other vegetables (12 *v.* 17 g/MJ per d), table sugar (3·4 *v.* 5·5 g/MJ per d) and fruit (4·8 *v.* 7·0 g/MJ per d). In effect the high-fat group achieved their relatively high energy intake with disproportionately higher intakes of butter, milk, eggs and confectionery and disproportionately lower intakes of low-fat foods, i.e. bread, potatoes, sugar and fruit.

A finding common to both approaches of assessing eating patterns of individuals with high-fat diets, either absolute or relative to energy, is their lower intake of carbohydrate-rich foods. Both approaches also indicated that high-fat diets were associated with higher intakes of milk, butter and confectionery products. Meat intakes were associated with a high-fat diet when fat intake was expressed relative to energy but not when fat intake was expressed in absolute terms. Either approach is more informative and constitutes a more powerful basis for developing a nutrition education programme than the traditional practice of examining the mean contribution of foods to the mean total fat intake (National Advisory Committee on Nutrition Education, 1983). Thus the traditional approach would have targeted meat as a food for reduced consumption given that it is quantitatively the biggest single source of fat in the diet (Table 4). However, by classifying men into those with fat intakes above or below 120 g/d, meat intake adjusted for energy intake did not discriminate between the two groups of high- and low-fat eaters.

Whilst the numbers in the sub-groups used in the present study are small, they represent a higher absolute and relative number than that recorded in Cambridgeshire by Nelson (1985) using a larger sample. Some 27% of men and 10% of women in the present study achieved the targets set by Nelson (1985), which contrasts with the numbers recorded for Cambridgeshire adults (8% of men and 3% of women). The more favourable position in Ireland is largely due to the higher consumption of bread and potatoes compared with the UK. Whilst this conservative reliance on high intakes of bread and potatoes may seem unfashionable, the declining intakes of these foods in Ireland (Kelly, 1985) should be strongly discouraged.

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Printed in Great Britain