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ORIGINAL COMMUNICATION

Social diversity of Irish adults nutritional intake

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Objective: The first health and lifestyle survey of Irish adults was carried out in 1998 and aimed to describe the health-related lifestyle behaviours of a cross-section of various population strata residing in the Republic of Ireland. This paper reports on the social variation in nutrient intake.
Design: A self-administered postal questionnaire, including a 149 food item semiquantitative food frequency section, from which nutrient intakes were estimated based on McCance and Widdowson food composition tables.
Setting: Community-based adults aged 18 years and over residing in the Republic of Ireland on the Register of Electors.
Subjects: A stratified sample of adults on the Register of Electors received the questionnaire, of which 6539 (62%) were returned.
Results: The contribution of fat to total energy intake increased with decreasing socioeconomic grouping, a finding reflective of the higher consumption levels of foods high in fat by respondents from socially disadvantaged groups. Energy from carbohydrates was greatest among those from socially advantaged groups, and was close to the recommended 50% of the total energy intake. Conversely, energy from protein decreased with increasing social status group. The mean intake of vitamins and minerals was generally close to or above the recommended values. Significant variation was observed among females across the different levels of education, whereas living with someone appeared to influence the micronutrient intake of males. The reported diets of males and females over the age of 65 years were lacking in vitamin D. Mean calcium levels among males were borderline and females over the age of 65 years had mean dietary iron levels below the recommended intake.
Conclusions: For the first time, quantification of nutrient intake in the different social groups in Ireland has been undertaken. A healthy balance of energy derived from fat, protein and carbohydrate is best achieved among respondents from higher social positions. The positive relation observed with healthy food intake and increasing education level was also present in macronutrient intake and a clear gender and social support interplay was seen in the nutrient intake levels.
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Keywords: nutrient intake; socioeconomic status; social inequality

Introduction

The relation between nutritional status and a variety of health outcomes is well established in the literature, although debate continues around the causal mechanisms (Kannell *et al*, 1979; Simons, 1986; Gunnell *et al*, 1998; Thorand *et al*, 1998). Some such health outcomes vary greatly in prevalence across different social groups (Whitehead, 1989; Davey Smith & Brunner, 1997; Power & Mathews, 1997) and these inequalities may be partly explained by social gradients in nutritional intake (Hupkens *et al*, 1997; James *et al*, 1997; Shaw *et al*, 1999; Eurodiet, 2001). Like many developed countries, Ireland exhibits marked social gradients in health outcomes and, compared to our European neighbours, has relatively high levels of diet-related chronic diseases (Cook, 1990; Nolan, 1994; CSO, 2000; Friel & Kelleher, 2000; Kelleher *et al*, 2001).

Irish health and food policies (NAG, 1995; DoHC, 1999,2000) have recognised the need to modify high-risk lifestyle behaviours, including adverse dietary habits that

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Contributors: SF is Assistant Academic Director in the Department of Health Promotion and is responsible for the co-ordination and management of the Survey of Lifestyle, Attitudes and Nutrition. She performed the majority of the data analyses and drafting of the paper. CK is Head of the Centre for Health Promotion Studies and senior scientist in charge of the Survey of Lifestyle, Attitudes and Nutrition. She was responsible for the design of the survey instrument, contributed to the interpretation of the data analyses and to the drafting of the Introduction and Discussion. GN is Consultant Nutritionist to the National Nutrition Surveillance Centre and provided dietary direction of the instrument development and paper. JH is Nutrition Researcher in the National Nutrition Surveillance Centre and was involved in data analyses of the food frequency questionnaire.
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impact on cardiovascular health and general well-being in all social groupings. The recommended dietary allowances (RDAs) for Ireland were recently updated by a working group established by the Food Safety Authority of Ireland (FSAI, 1999). RDAs were determined, which identified the required intake of various nutrients that would adequately meet the nutrient needs of most healthy people. It is self-evidently complex and impracticable to set dietary recommendations for all population subgroups and thus RDAs are set for the nation as a whole. However, to help reduce inequalities in health the social variability in food and nutrient intake must be recognised and redressed through appropriate policy and intervention.

Until recently there was no data available that would facilitate the determination of nutrient intake across the various subgroups of the Irish population. The North/South Ireland food consumption survey (IUNA, 2001) has provided very useful indepth nutrient data, but statistically powerful only at the total population level. In 1998, the Irish ministerial Department of Health and Children commissioned the national health and lifestyle survey, SLÁN (Survey of Lifestyle, Attitudes and Nutrition) to provide baseline information on a range of lifestyle-related health behaviours, including diet, across the various social strata. The aim of this paper is to report for the first time, using data from SLAN, on the quantification of social variation in nutrient intake among Irish adults and to identify those social indicators most predictive of energy derived from protein, fat and carbohydrate intake.

Methods

The subjects and methods used in the health and lifestyle survey have been described in detail elsewhere (Friel *et al*, 2001, Friel & Kelleher 2000). Briefly, a stratified probability sampling design was used and a sample of adults aged 18 years and over on the Electoral Register was drawn across each of the Republic's 26 counties, proportionately distributed according to the urban/rural breakdown in each county. Each selected adult was sent a self-administered questionnaire, of which 6539 (62%) were returned.

The questionnaire comprised eight sections and included a 149 food item semiquantitative food frequency for the purposes of estimating usual food and nutrient intake. An adapted version of the semi-quantitative food frequency questionnaire (SQFFQ) used in the British arm of the European Prospective Investigation of Cancer study, EPIC, (Bingham *et al*, 1997; Riboli & Kaaks, 1997) was utilised. The daily intake of energy and nutrients was computed from the food frequency data using a specially written computer program in FoxPro™ that linked the frequency selections with the cooked food equivalents in McCance and Widdowson Food Tables 5th Edition (McCance & Widdowson, 1997).

Self-reported height and weight were also recorded. Social status details were recorded including age, sex, social class, level of education, medical card eligibility, marital status, number of people living in the household and locality of dwelling. The social class of respondents was determined based on the occupation of the principal wage earner in the household and was categorised based on the Irish Census 1996 classification system (CSO, 1996). Social classes 1–2 correspond to professional, managerial and technical; social classes 3–4 include non-manual and skilled-manual occupations; and social classes 5–6 relate to semiskilled and unskilled labour.

Statistical analyses

As described in Friel *et al* (2001), questionnaires were removed from the data set if there were two or more blank pages in the food frequency section and the energy intake was ± 2.5 standard deviations from the sample mean (Clarke & Cooke, 1998). A total of 560 questionnaires were removed from the data set. Those nutrients that contribute to energy intake (ie protein, fat, carbohydrate and alcohol) are reported in terms of their percentage contribution to total energy intake. Means and standard errors of nutrient intake are reported and differences in age-adjusted mean intake of nutrients across the various social status groupings were tested using one-way ANCOVAs. The Kolmogorov–Smirnov goodness of fit test was used to check the distribution of nutrient intake and while not all were normally distributed, differences in the mean nutrient intake between social groups have been tested on the premise of the sample size and Central Limit Theorem (Clarke & Cooke, 1998; Samuels & Witmer, 1999). Only statistical significance, set at 1% because of the large number of tests being performed, is indicated only to the already complex data tables. Tables of results and their interpretation are presented for socio-economic indicators (social class, education, medical card status) and social support type factors (marital status, number living in household and locality of dwelling). Only textual information is given for specific gender and age differences given that the main thrust of the paper is about social gradients in nutrient intake and also because of the already large volume of information within the paper it was considered best from brevity.

A linear multiple regression model was used to test the influence of each social status indicator on the dietary energy derived from fat, protein and carbohydrate. Models were developed separately for males and females. The following independent variables were entered together into each model: age, level of education (tertiary *vs* other, none/primary only *vs* other), social class (social class 1/2 *vs* other, social class 5/6 *vs* other), medical card eligibility (yes or no), marital status (married/cohabiting *vs* other, previously married *vs* other), location of dwelling (urban *vs* rural) and the number living in a household (alone *vs* living with others). Data were analysed using SPSS version 9.0 (SPSS, 1999).

Results

As described in Friel *et al* (2001) the data show similar age, gender and social class distributions to the most recent national Census figures (CSO, 1996), but with slightly lower representation of females. There were a number of significant trends observed in the estimated mean daily intake of energy and nutrients across the various social groupings in SLAN, where possible energy and nutrient intakes have been compared with the updated recommended dietary allowances, Table 1 (FSAI, 1999).

Gender

Males had a significantly higher mean daily intake of total energy, a significantly greater percentage contribution to energy by fat, saturated fat, monounsaturated fat and alcohol and a higher mean dietary cholesterol level compared to females. Mean levels of protein per kg of body weight, energy from polyunsaturated fats, carbohydrate and fibre were significantly greater among females than males. Of the macronutrients estimated, only energy derived from protein did not differ significantly between the sexes. There were a number of differences in micronutrient intake between males and females. Overall, males had higher mean levels of vitamins A, B_{12}, riboflavin, calcium and zinc. The mean vitamin C and thiamin levels were significantly greater among females than males. Regardless of gender, mean selenium levels were lower than those recommended. Excess intakes were observed for vitamin B_{12} that showed a mean of more than 5 times than recommended and phosphorous almost three times.

Age

The intake of almost all nutrients derived from foodstuffs differed significantly between the three age groups among males, with those over 65 years more likely to have the lowest estimated mean intake. Mean energy intakes among males in all age groups, except those aged 75 years and over, who were participating at the recommended weekly physical activity were lower than the FSAI (1999) recommended energy intake. The mean energy intake among males not participating in regular moderate physical activity was similar to that recommended. The mean grams per kilogram of body weight per day of protein consumed by males under 65 years was 1.25 (s.d. 0.6) and 1.12 (s.d. 0.6) for those 65 years and over. In both age groups, the mean protein intake was substantially greater than that recommended. The mean daily vitamin and mineral intakes for males in all age groups were similar to or in excess of those recommended by the Food Safety Authority. However, there appeared to be a deficiency of vitamin D among males aged 65 years and over and the mean calcium levels were slightly lower than recommended. Unlike all other vitamins and minerals, the mean intake of vitamins A and C did not differ significantly across the three age groups.

Table 1 Recommended adult dietary allowances for Ireland 1999 (FSAI 1999)

	Protein (g/kg body weight/day)	*n-6 PUFA (% dietary energy)*	*n-12 PUFA (% dietary energy)*	*Thiamin (μg/MJ)*	*Riboflavin (mg/day)*	*Niacin (mg/MJ)*	*Vit A (μg/day)*	*Vit B_6 (μg/g protein)*	*Vit B_{12} (μg/day)*	*Vit C (mg/day)*
Males										
18–64 years	0.75	2	0.5	100	1.6	1.6	700	15	1.4	60
65+years	0.75	2	0.5	100	1.6	1.6	700	15	1.4	60
Females										
18–64 years	0.75	2	0.5	100	1.6	1.6	600	15	1.4	60
65+years	0.75	2	0.5	100	1.6	1.6	600	15	1.4	60
	Vit D (μg/day)	*Folate (μg/day)*	*Calcium (mg/day)*	*Phosphorus (mg/day)*	*Potassium (mg/day)*	*Iron (mg/day)*	*Zinc (mg/day)*	*Copper (mg/day)*	*Selenium (μg/day)*	*Iodine (μg/day)*
Males										
18–64 years	0–10	300	800	550	3100	10	9.5	1.1	55	130
65+years	10	300	800	550	3100	10	9.5	1.1	55	130
Females										
18–64 years	0–10	300	800	550	3100	14	7	1.1	55	130
65+years	10	300	800	550	3100	9	7	1.1	55	130

Table 2 Social status variation in age-adjusted mean (SE) daily energy and nutrient intake of males (sample *n*=5979)

	Social class			*Education*			*Medical card*	
	SC 1/2 (n=*705*)	*SC 3/4* (n=*737*)	*SC 5/6* (n=*452*)	*None/Prim* (n=*595*)	*Second level* (n=*1188*)	*Third level* (n=*772*)	*Yes* (n=*667*)	*No* (n=*1919*)
Energy (MJ)	10.0 (0.2)	9.63 (0.2)	9.49 (0.2)	9.02 (0.2)	9.40 (0.1)	9.60 (0.2)	9.42 (0.2)	9.28 (0.1)
Protein (g/kg body weight/day)	1.25 (0.02)	1.27 (0.02)	1.26 (0.03)	1.26 (0.03)	1.24 (0.02)	1.22 (0.02)	1.23 (0.02)	1.23 (0.01)
Protein (E%)	17.2 (0.2)*	17.9 (0.2)	17.7 (0.2)	19.2 (0.2)*	18.0 (0.1)	17.3 (0.2)	17.9 (0.2)	18.0 (0.1)
Fat (E%)	33.9 (0.3)*	35.1 (0.2)	35.5 (0.3)	35.2 (0.3)*	35.0 (0.2)	33.2 (0.3)	34.9 (0.3)	34.4 (0.2)
MUFA (E%)	10.8 (0.1)*	11.2 (0.1)	11.3 (0.1)	11.1 (0.1)*	11.1 (0.08)	10.5 (0.1)	11.1 (0.1)	10.9 (0.06)
PUFA (E%)	4.66 (0.09)	4.75 (0.08)	4.61 (0.1)	4.21 (0.1)*	4.67 (0.1)	4.63 (0.09)	4.64 (0.08)	4.49 (0.05)
SFA (E%)	12.0 (0.1)*	12.6 (0.1)	13.3 (0.2)	13.8 (0.2)*	12.7 (0.1)	11.9 (0.2)	12.6 (0.2)	12.7 (0.1)
Carbohydrate (E%)	48.6 (0.3)	47.5 (0.3)	47.5 (0.4)	47.1 (0.4)*	47.6 (0.3)	49.3 (0.3)	47.8 (0.3)	48.0 (0.2)
Alcohol (E%)	3.32 (0.2)*	2.42 (0.2)	2.26 (0.2)	1.44 (0.2)*	2.43 (0.1)	3.40 (0.2)	2.40 (0.2)	2.58 (0.1)
Cholesterol (mg)	308.7 (5.9)	315.1 (5.8)	309.6 (7.4)	314.6 (8.0)	311.2 (4.9)	294.9 (6.2)	308.2 (6.0)	304.1 (3.8)
Fibre (g)	23.3 (0.4)	21.7 (0.4)	21.8 (0.5)	20.4 (0.6)*	21.8 (0.3)	22.9 (0.4)	22.2 (0.4)	21.5 (0.3)
Vitamin A (μg)	882.2 (38.8)	919.1 (38.2)	979.1 (48.8)	925.9 (58.1)	953.4 (36.1)	852.8 (45.5)	985.0 (46.0)	901.0 (29.2)
Vitamin B6 (μg/g protein)	29.6 (0.3)	29.0 (0.3)	28.7 (0.4)	27.3 (0.4)*	29.0 (0.3)	30.0 (0.3)	29.3 (0.3)	28.8 (0.2)
Vitamin B12 (μg)	6.44 (0.2)	6.80 (0.2)	6.92 (0.2)	6.86 (0.3)	6.81 (0.2)	6.23 (0.2)	6.82 (0.2)	6.59 (0.1)
Vitamin C (mg)	104.2 (2.4)*	88.6 (2.3)	84.6 (3.0)	75.0 (3.2)*	90.1 (2.0)	105.2 (2.5)	93.0 (2.5)	90.1 (1.6)
Vitamin D (μg)	3.39 (0.09)	3.48 (0.09)	3.15 (0.1)	3.11 (0.1)	3.22 (0.1)	3.34 (0.1)	3.31 (0.09)	3.22 (0.06)
Folate (μg)	316.2 (5.2)*	296.7 (5.1)	293.0 (6.5)	278.3 (6.9)*	294.4 (4.3)	311.1 (5.4)	300.2 (5.4)	292.4 (3.4)
Thiamin (μg/MJ energy)	187.7 (1.9)	193.0 (1.8)	194.7 (2.4)	208.9 (2.7)*	195.8 (1.7)	191.6 (2.1)	197.9 (2.1)	196.3 (1.3)
Riboflavin (mg)	2.04 (0.03)	2.02 (0.03)	1.97 (0.04)	1.97 (0.04)	1.93 (0.03)	1.99 (0.04)	1.95 (0.03)	1.95 (0.02)
Phosphorous (mg)	1589 (22.0)	1535 (21.5)	1493 (27.6)	1458 (28.4)	1486 (17.6)	1551 (22.3)	1490 (22.0)	1490 (13.9)
Calcium (mg)	1001 (17.2)	959.6 (16.8)	936.3 (21.5)	909.7 (21.4)	919.0 (13.3)	969.9 (16.8)	926.2 (16.5)	928.5 (10.4)
Iron (mg)	13.4 (0.3)	12.5 (0.3)	12.4 (0.3)	12.5 (0.4)	12.2 (0.2)	13.2 (0.3)	12.6 (0.3)	12.4 (0.2)
Selenium (μg)	56.7 (1.1)	54.2 (1.1)	54.8 (1.4)	53.7 (1.4)	53.9 (0.9)	54.7 (1.1)	54.5 (1.1)	53.6 (0.7)
Zinc (mg)	12.0 (0.2)	11.9 (0.2)	11.6 (0.3)	11.7 (0.3)	11.8 (0.2)	11.6 (0.2)	11.6 (0.2)	11.6 (0.1)

	Marital status			*Location*		*No. household*	
	Married (n=*1436*)	*Previous* (n=*197*)	*Single* (n=*1068*)	*Urban* (n=*1270*)	*Rural* (n=*1317*)	*Alone* (n=*389*)	*>1* (n=*2276*)
Energy (MJ)	9.50 (0.1)	8.75 (0.3)	9.24 (0.1)	9.21 (0.1)	9.42 (0.1)	8.38 (0.2)*	9.58 (0.09)
Protein (g/kg body weight/day)	1.22 (0.02)	1.14 (0.04)	1.27 (0.02)	1.21 (0.01)	1.24 (0.02)	1.11 (0.03)*	1.26 (0.01)
Protein (E%)	17.8 (0.1)	18.2 (0.4)	18.3 (0.2)	17.8 (0.1)	18.2 (0.1)	17.9 (0.2)	18.0 (0.1)
Fat (E%)	34.4 (0.2)	34.9 (0.5)	34.7 (0.2)	34.2 (0.2)*	34.9 (0.2)	34.4 (0.4)	34.6 (0.2)
MUFA (E%)	11.0 (0.07)	11.1 (0.2)	11.0 (0.09)	10.8 (0.08)	11.1 (0.08)	10.8 (0.1)	11.0 (0.06)
PUFA (E%)	4.76 (0.06)*	4.37 (0.2)	4.34 (0.08)	4.62 (0.07)	4.50 (0.07)	4.28 (0.1)	4.63 (0.05)
SFA (E%)	12.6 (0.1)	13.0 (0.2)	12.7 (0.2)	12.5 (0.1)	12.9 (0.1)	12.5 (0.3)	12.7 (0.1)
Carbohydrate (E%)	48.4 (0.2)*	46.8 (0.7)	47.6 (0.3)	47.8 (0.3)	48.1 (0.3)	47.2 (0.5)	48.1 (0.2)
Alcohol (E%)	2.38 (0.1)	3.10 (0.3)	2.47 (0.1)	3.26 (0.1)*	1.79 (0.1)	3.44 (0.2)*	2.38 (0.09)
Cholesterol (mg)	307.0 (4.5)	303.5 (12.3)	306.8 (5.3)	290.9 (4.7)*	319.4 (4.6)	277.0 (8.8)*	312.8 (3.5)
Fibre (g)	22.6 (0.3)*	18.7 (0.9)	21.1 (0.4)	21.4 (0.3)	22.0 (0.3)	18.7 (0.6)*	22.3 (0.2)

Table 2 (*Continued*)

	Marital status			*Location*		*No. household*	
	Married (n=1436)	*Previous* (n=197)	*Single* (n=1068)	*Urban* (n=1270)	*Rural* (n=1317)	*Alone* (n=389)	*>1* (n=2276)
Vitamin A (µg)	919.7 (33.3)	876.5 (91.5)	942.6 (39.8)	879.0 (34.2)	956.9 (34.3)	862.6 (65.6)	940.8 (26.2)
Vitamin B6 (µg/g protein)	29.3 (0.2)	27.6 (0.7)	28.6 (0.3)	29.3 (0.2)	28.7 (0.2)	28.9 (0.5)	29.0 (0.2)
Vitamin B12 (µg)	6.59 (0.2)*	6.43 (0.4)	6.84 (0.2)	6.44 (0.2)	6.84 (0.2)	6.18 (0.3)*	6.79 (0.1)
Vitamin C (mg)	96.6 (1.8)*	77.1 (4.9)	85.3 (2.1)	92.8 (1.9)	88.6 (1.8)	77.4 (3.5)*	93.7 (1.4)
Vitamin D (µg)	3.37 (0.06)*	2.87 (0.2)	3.16 (0.08)	3.19 (0.07)	3.29 (0.07)	2.85 (0.1)*	3.32 (0.05)
Folate (µg)	306.4 (3.9)*	257.8 (10.6)	286.8 (4.6)	290.3 (4.1)	299.6 (4.0)	259.0 (7.6)*	303.0 (3.0)
Thiamin (µg/MJ energy)	198.7 (1.5)*	181.6 (4.1)	197.6 (1.8)	188.2 (1.6)*	205.7 (1.6)	188.7 (3.0)*	198.1 (1.2)
Riboflavin (mg)	1.94 (0.02)	1.91 (0.07)	1.98 (0.03)	1.90 (0.03)*	2.01 (0.03)	1.85 (0.05)*	1.99 (0.02)
Phosphorous (mg)	1502 (16.1)	1426 (44.3)	1492 (19.2)	1479 (16.9)	1501 (16.7)	1385 (31.4)*	1522 (12.6)
Calcium (mg)	924.2 (12.1)	923.2 (33.3)	935.8 (14.4)	911.5 (12.7)	947.3 (12.5)	887.8 (23.8)*	942.7 (9.5)
Iron (mg)	12.8 (0.2)*	10.7 (0.5)	12.5 (0.2)	12.5 (0.2)	12.5 (0.2)	10.6 (0.4)*	12.9 (0.2)
Selenium (µg)	55.4 (0.8)*	48.4 (2.2)	52.5 (0.9)	53.3 (0.8)*	53.7 (0.8)	46.8 (1.5)*	55.3 (0.6)
Zinc (mg)	11.8 (0.1)	10.8 (0.4)	11.6 (0.2)	11.2 (0.2)*	11.9 (0.2)	10.1 (0.3)*	11.9 (0.1)

*$P<0.01$: significant difference in mean intake within social groupings.
SC1-2=professional, managerial and technical, SC3-4=nonmanual and skilled manual, SC5-6=semiskilled and unskilled.
Previously married=widowed, separated, divorced.

The mean intake of all nutrients reduced with increasing age among females, except that of energy from carbohydrate, dietary cholesterol and vitamin B_6. Female's mean energy intakes were close to or slightly greater than the recommended levels among both those participating and not participating in regular moderate physical activity. Similar mean protein intakes were estimated for females as for males with a mean intake of 1.46 (s.d. 0.7) for those under 65 years and 1.31 (s.d. 0.7) for 65 years and over. Again, as with males, the mean protein intake was substantially greater than that recommended. The mean percentage contribution to total energy from protein, fat and carbohydrate varied significantly across the three age groups in both male and female respondents. The energy from protein increased significantly with increasing age and likewise carbohydrate-related energy increased with age among males. The energy from fat decreased significantly with increasing age in both males and females. Similar mean levels of micronutrient intake were estimated among females as in males. Compared to the other age groups, low mean levels of vitamin D and iron were detected among those over 65 years. The estimated mean intake of vitamin B_6 per gram of protein did not differ significantly across the three age groups.

Social class

The age-adjusted mean daily intake of most macronutrients differed significantly by social class, more so for females than males (Tables 2 and 3). The mean contribution of protein and fat to total energy increased with decreasing social class, whereas the contribution of carbohydrate to energy intake was greatest among higher social classes, significantly so for females. The mean percentage contribution of alcohol to total energy intake was significantly greater among higher social classes in both males and females. Of the micronutrients, mean folate intake did not vary among females but did so among males.

Education

There was substantially more variation in mean nutrient intake by the level of education than social class. Only eight of the 23 mean nutrient intakes reported did not vary significantly between the education levels in females but, as with social class, this variation was less marked among males (Tables 2 and 3). There was a significant inverse relation between female education level and mean intake of energy from protein, total fat, monounsaturated fat, saturated fat and intake of vitamins A and B_{12}. Females with little or no education had significantly lower mean daily intakes of fibre, energy from carbohydrate and alcohol, vitamin C, folate, phosphorous and calcium and iron. Males with little or no education had significantly lower mean intakes of energy from polyunsaturated fatty acids, carbohydrates and alcohol, fibre, vitamins B_6, C and folate. Mean thiamin levels were significantly greater in males of little or no formal

Table 3 Social status variation in age-adjusted mean (s.e.) daily energy and nutrient intake of females (sample *n*=5979)

	Social class			*Education*			*Medical card*	
	SC 1/2 (n=*987*)	*SC 3/4* (n=*862*)	*SC 5/6* (n=*371*)	*None / Prim* (n=*512*)	*2nd level* (n=*1490*)	*3rd level* (n=*893*)	*Yes* (n=*905*)	*No* (n=*2085*)
Energy (MJ)	9.13 (0.1)	9.10 (0.1)	9.60 (0.2)	8.42 (0.2)	9.00 (0.1)	8.88 (0.1)	8.79 (0.1)	8.90 (0.08)
Protein (g/kg body weight/day)	1.46 (0.02)*	1.45 (0.02)	1.57 (0.03)	1.36 (0.04)	1.47 (0.02)	1.45 (0.02)	1.45 (0.02)	1.44 (0.02)
Protein (E%)	17.4 (0.1)	17.4 (0.1)	17.9 (0.2)	18.8 (0.2)*	17.8 (0.1)	17.3 (0.2)	17.9 (0.2)	17.9 (0.1)
Fat (E%)	33.2 (0.2)*	34.3 (0.2)	35.2 (0.4)	34.9 (0.4)*	34.1 (0.2)	32.6 (0.3)	33.8 (0.3)	33.8 (0.2)
MUFA (E%)	10.4 (0.09)*	10.8 (0.1)	11.2 (0.1)	10.9 (0.2)*	10.7 (0.08)	10.2 (0.1)	10.5 (0.1)	10.6 (0.06)
PUFA (E%)	4.90 (0.07)	5.16 (0.08)	4.93 (0.1)	4.79 (0.1)	4.94 (0.06)	4.70 (0.08)	4.85 (0.08)	4.87 (0.05)
SFA (E%)	12.0 (0.1)*	12.6 (0.1)	13.3 (0.2)	13.8 (0.2)*	12.7 (0.1)	11.9 (0.2)	12.6 (0.2)	12.7 (0.1)
Carbohydrate (E%)	50.6 (0.3)*	50.0 (0.3)	48.8 (0.5)	48.4 (0.5)*	49.9 (0.2)	51.2 (0.3)	50.1 (0.3)	50.0 (0.2)
Alcohol (E%)	2.02 (0.08)*	1.50 (0.09)	1.18 (0.1)	0.90 (0.1)*	1.28 (0.06)	2.05 (0.08)	1.37 (0.09)	1.51 (0.05)
Cholesterol (mg)	273.3 (4.5)	274.6 (4.8)	298.2 (7.4)	280.6 (7.7)	277.1 (3.9)	261.7 (5.3)	271.0 (5.2)	273.8 (3.3)
Fibre (g)	23.8 (0.4)	23.4 (0.4)	23.8 (0.6)	20.6 (0.6)*	23.0 (0.3)	23.5 (0.4)	22.4 (0.4)	22.9 (0.3)
Vitamin A (μg)	731.4 (27.4)	803.9 (29.4)	879.7 (45.0)	942.9 (51.8)*	813.3 (26.1)	686.9 (35.6)	770.0 (36.6)	808.7 (22.9)
Vitamin B6 (μg/g protein)	29.1 (0.2)	29.4 (0.2)	29.3 (0.4)	28.1 (0.4)	29.1 (0.2)	29.7 (0.3)	29.1 (0.3)	29.2 (0.2)
Vitamin B12 (μg)	5.46 (0.2)*	5.83 (0.2)	6.59 (0.2)	6.56 (0.3)*	6.01 (0.1)	5.10 (0.2)	5.82 (0.2)	5.85 (0.1)
Vitamin C (mg)	126.5 (2.5)*	114.4 (2.7)	105.8 (4.2)	87.1 (4.2)*	114.8 (2.1)	125.0 (2.9)	111.7 (2.9)	114.6 (1.8)
Vitamin D (μg)	3.51 (0.1)	3.42 (0.1)	3.71 (0.2)	3.24 (0.1)	3.30 (0.08)	3.38 (0.1)	3.38 (0.1)	3.35 (0.07)
Folate (μg)	309.3 (4.4)	304.2 (4.7)	311.1 (7.2)	272.3 (7.8)*	304.2 (4.0)	307.2 (5.4)	293.9 (5.3)	303.3 (3.3)
Thiamin (μg/MJ energy)	201.6 (2.3)	199.1 (2.5)	201.3 (3.8)	212.0 (3.8)	204.2 (1.9)	202.1 (2.6)	205.2 (2.5)	205.1 (1.6)
Riboflavin (mg)	1.84 (0.03)	1.81 (0.03)	1.96 (0.04)	1.79 (0.05)	1.85 (0.02)	1.80 (0.03)	1.80 (0.03)	1.84 (0.02)
Phosphorous (mg)	1480 (17.7)	1430 (19.0)	1497 (28.9)	1331 (30.1)*	1438 (15.2)	1444 (20.8)	1416 (20.5)	1423 (12.8)
Calcium (mg)	922.3 (13.6)	874.7 (14.6)	896.6 (22.2)	810.5 (23.2)*	886.8 (11.7)	911.6 (16.0)	877.3 (15.8)	879.6 (9.8)
Iron (mg)	13.2 (0.2)	12.8 (0.2)	13.4 (0.4)	11.8 (0.4)*	12.7 (0.2)	13.4 (0.3)	12.7 (0.3)	12.8 (0.2)
Selenium (μg)	51.8 (0.8)	52.8 (0.9)	53.3 (1.4)	49.2 (1.4)	51.3 (0.7)	50.7 (1.0)	49.7 (1.0)	51.2 (0.6)
Zinc (mg)	10.8 (0.2)*	10.9 (0.2)	11.9 (0.2)	10.5 (0.3)3*	11.1 (0.1)	10.3 (0.2)	10.8 (0.2)	10.8 (0.1)

	Marital status			*Location*		*No. household*	
	Married (n=*1710*)	*Previous* (n=*453*)	*Single* (n=*921*)	*Urban* (n=*1400*)	*Rural* (n=*1559*)	*Alone* (n=*398*)	*>1* (n=*2653*)
Energy (MJ)	8.97 (0.1)	8.63 (0.2)	8.82 (0.1)	8.74 (0.1)	8.93 (0.1)	8.45 (0.2)	8.96 (0.08)
Protein (g/kg body weight/day)	1.45 (0.02)	1.35 (0.04)	1.46 (0.02)	1.41 (0.02)	1.46 (0.02)	1.36 (0.04)	1.45 (0.01)
Protein (E%)	17.9 (0.1)	18.0 (0.3)	17.6 (0.2)	17.6 (0.1)*	18.0 (0.1)	17.4 (0.3)	17.9 (0.1)
Fat (E%)	34.0 (0.2)	34.1 (0.4)	33.2 (0.3)	33.5 (0.2)	34.0 (0.2)	33.3 (0.4)	33.9 (0.2)
MUFA (E%)	10.7 (0.07)	10.6 (0.2)	10.4 (0.1)	10.5 (0.08)	10.6 (0.08)	10.4 (0.2)	10.6 (0.06)
PUFA (E%)	4.99 (0.06)*	4.82 (0.1)	4.61 (0.08)	4.81 (0.06)	4.87 (0.06)	4.64 (0.1)	4.89 (0.05)
SFA (E%)	12.6 (0.1)	13.0 (0.2)	12.7 (0.2)	12.5 (0.1)	12.9 (0.1)	12.5 (0.3)	12.7 (0.1)
Carbohydrate (E%)	49.8 (0.2)	49.7 (0.5)	50.7 (0.3)	50.3 (0.2)	49.8 (0.2)	50.8 (0.5)	49.9 (0.2)
Alcohol (E%)	1.37 (0.06)*	1.39 (0.1)	1.72 (0.09)	1.80 (0.07)*	1.19 (0.06)	1.70 (0.1)	1.47 (0.05)
Cholesterol (mg)	280.2 (3.6)*	263.6 (8.0)	262.8 (5.3)	263.6 (4.0)*	279.0 (3.8)	252.0 (8.1)*	276.0 (2.9)
Fibre (g)	23.5 (0.3)*	21.9 (0.6)	22.1 (0.4)	22.1 (0.3)*	23.4 (0.3)	21.5 (0.7)	23.1 (0.2)
Vitamin A (μg)	801.9 (25.5)	771.1 (56.1)	807.8 (37.1)	759.1 (27.5)	816.6 (26.2)	686.8 (53.7)	809.1 (19.3)
Vitamin B6 (μg/g protein)	29.1 (0.2)	29.0 (0.4)	29.6 (0.3)	29.6 (0.2)	28.9 (0.2)	28.9 (0.4)	29.3 (0.2)

Table 3 (*Continued*)

	Marital status			Location		No. household	
	Married (n=1710)	*Previous* (n=453)	*Single* (n=921)	*Urban* (n=1400)	*Rural* (n=1559)	*Alone* (n=398)	*>1* (n=2653)
Vitamin B12 (μg)	5.99 (0.1)	5.39 (0.3)	5.71 (0.2)	5.62 (0.2)	5.92 (0.1)	4.96 (0.3)*	5.92 (0.1)
Vitamin C (mg)	118.1 (2.0)*	105.1 (4.4)	110.0 (2.9)	112.8 (2.2)	114.0 (2.1)	108.3 (4.5)	115.0 (1.6)
Vitamin D (μg)	3.54 (0.1)*	3.27 (0.2)	3.02 (0.1)	3.30 (0.09)	3.37 (0.08)	3.19 (0.2)	3.37 (0.1)
Folate (μg)	305.4 (3.7)	283.6 (8.1)	299.8 (5.4)	295.0 (4.0)*	303.3 (3.8)	283.0 (8.3)	303.6 (3.0)
Thiamin (μg/MJ energy)	205.5 (1.8)	201.8 (3.9)	205.6 (2.6)	200.8 (2.0)*	208.6 (1.9)	197.7 (4.0)	206.0 (1.4)
Riboflavin (mg)	1.82 (0.02)	1.76 (0.05)	1.86 (0.03)	1.79 (0.02)	1.85 (0.02)	1.76 (0.05)	1.84 (0.02)
Phosphorous (mg)	1437 (14.2)	1372 (31.3)	1418 (20.7)	1399 (15.6)	1434 (14.9)	1379 (31.9)	1431 (11.5)
Calcium (mg)	873.5 (10.9)	858.2 (24.1)	900.3 (15.9)	873.4 (12.1)	884.0 (11.5)	894.0 (24.7)	881.2 (8.9)
Iron (mg)	13.2 (0.2)	12.2 (0.4)	12.4 (0.3)	12.5 (0.2)	13.0 (0.2)	11.8 (0.4)	13.0 (0.2)
Selenium (μg)	52.4 (0.7)*	48.2 (1.5)	49.1 (1.0)	49.7 (0.8)	51.1 (0.7)	47.0 (1.5)*	51.4 (0.5)
Zinc (mg)	11.1 (0.1)*	10.0 (0.3)	10.4 (0.2)	10.4 (0.1)*	11.0 (0.1)	9.54 (0.3)*	10.9 (0.1)

$^{*}P<0.01$: significant difference in mean intake within social groupings.
SC1-2=professional, managerial and technical, SC3-4=nonmanual and skilled manual, SC5-6=semiskilled and unskilled.
Previously married=widowed, separated, divorced.

education compared to those with secondary or tertiary level.

Medical card status

There was no statistically significant variation in the mean intake of energy and nutrients by medical card status of both males and females.

Marital status

A clear pattern emerged among males, such that where the age-adjusted mean intake of a nutrient varied significantly across marital status, it was the previously married males who had the lower mean intake (Table 2). This was the case for mean percentage energy from carbohydrates, fibre intake, vitamins C and D, folate, thiamin, iron and selenium. The marital status variation of nutrient intake among females was not quite so consistent. Previously, married females had significantly lower mean intakes of fibre, vitamin C, selenium and zinc, whereas energy from polyunsaturated fats, dietary cholesterol and vitamin D was lowest in single females (Table 3).

Number in household

Of the 23 energy and nutrients reported, the age-adjusted mean daily intake for 12 of them was significantly lower among males living alone compared to those living in a house with others. The only nutrient whose mean intake was greater among males living alone compared to those living with others was that of alcohol (Table 2). Substantially fewer nutrients showed significant variation among females based on the number living in the household. The mean intake of dietary cholesterol, vitamin B_{12}, selenium and zinc was greater among females living with others compared to those living alone (Table 3).

Location

A number of macro- and micronutrient intakes varied significantly between respondents, particularly males, living in urban and rural locations (Tables 2 and 3). Both males and females living in urban localities had significantly lower mean daily intakes of dietary cholesterol, thiamin and zinc compared to their rural counterparts. Urban males in addition had significantly lower mean energy from fat and riboflavin and the energy from protein and fibre was significantly lower among urban females compared to those from rural areas. The mean percentage energy derived from alcohol among urban males and females was significantly greater than that of rural respondents.

Multivariate analyses

Multivariate analyses were carried out to determine which social status indicators were most influential in predicting the percentage energy from fat, protein and carbohydrate. Table 4 summarises the standardised beta coefficients, *P*-values and other estimates from the gender specific multiple regression models. The maximum variation explained by the social status indicators was 7% for percentage energy from fat among males. A 3% of variation in energy from protein and carbohydrate was explained by the social indicators. The explained variance in energy from fat, protein and carbohydrate was 3% or less in each model for females. Not all independent variables remained significantly predictive of the percentage energy contribution by the three macronutrients. The only socioeconomic factor that remained strongly and consistently predictive of each of the three macronutrient contributions to energy intake was education, except in the case of energy from protein in females. Both location of dwelling and whether living alone or not remained predictive of energy from fat and marital status predictive of energy from carbohydrate for males. The only significant social support type indicator among females was living alone or not being predictive of energy from carbohydrate.

Discussion

This study provides novel data on estimated nutrient intake in a representative sample of the Irish population, affording an examination of social variations in nutrient intake pattern. A very good response rate for a postal questionnaire of its type was achieved suggesting confidence in the survey's representation of the Irish adult population.

The social variations in nutrient intake mirrored to a certain extent those observed in the food consumption data (Friel *et al*, 2001). For example, positive social class and education gradients observed in higher mean intakes of foods low in saturated fat, higher in folate and fibre were reflected in the nutrient levels. Although the nutrient variation was less marked, a finding observed in other similar surveys (Hupkens *et al*, 1997), this is possibly because

Table 4 Linear regression models of social status variables on dependent variables percentage energy from fat, protein and carbohydrate (sample *n*=5979)

		Fat E%		*Protein E%*		*Carbohydrate E%*	
		β	t *value*	β	t *value*	β	t *value*
Males							
Age (years):		−0.225	−6.22**	0.037	1.02	0.142	3.87**
Level of education:	Tertiary	0.085	2.96**	0.061	2.11*	−0.075	−2.55*
	Secondary	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)
	None/primary	−0.062	−1.98*	−0.119	−3.76**	0.109	3.46
Social class:	Social class 1/2	0.027	0.91	0.057	1.92	-0.014	−0.47
	Social class 3/4	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)
	Social class 5/6	−0.005	−0.18	0.061	2.15*	−0.022	−0.79
Medical card eligibility:	No=0, yes=1	0.042	1.68	−0.020	−0.80	−0.029	−1.15
Marital status:	Married	0.063	1.92	0.021	0.65	−0.079	−2.38*
	Single/never married	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)
	Previously married	−0.005	−0.19	−0.007	−0.25	0.019	0.67
Location of dwelling:	Rural=0, urban=1	−0.066	−2.59*	−0.027	−1.05	−0.008	−0.31
Number in household:	With others=0, alone=1	−0.062	−2.04*	−0.045	−1.44	0.047	1.52
		Model F=10.71, $P<0.001$, r^2=0.070		Model F=5.66, $P<0.001$, r^2=0.030		Model F=6.53, $P<0.001$, r^2=0.030	
Females							
Age (years):		−0.117	−3.81*	0.129	4.20**	0.064	2.06*
Level of education:	Tertiary	0.064	2.39*	0.042	1.56	−0.056	−2.10*
	Secondary	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)
	None/primary	−0.010	−0.37	−0.041	−1.54	0.023	0.85
Social class:	Social class 1/2	0.063	2.32*	−0.016	−0.60	−0.026	−0.96
	Social class 3/4	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)
	Social class 5/6	−0.023	−0.88	−0.027	−1.06	0.032	1.21
Medical card eligibility:	No=0, yes=1	0.019	0.81	0.014	0.60	−0.011	−0.47
Marital status:	Married	−0.022	−0.75	−0.008	−0.27	−0.001	−0.04
	Single/never married	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)
	Previously married	−0.012	−0.42	0.017	0.60	−0.012	−0.42
Location of dwelling:	Rural=0, urban=1	−0.039	−1.64	−0.036	−1.52	0.017	0.74
Number in household:	With others=0, alone=1	−0.039	−1.48	−0.042	−1.58	0.063	2.36*
		Model F=4.86, $P<0.001$, r^2=0.021		Model F=5.74, $P<0.001$, r^2=0.026		Model F=2.87, $P<0.01$, r^2=0.010	

*$P<0.05$, **$P<0.01$.

of the contribution of differing food sources in the different social groups and must be borne in mind since important for educational and promotional purposes. A healthy balance of energy derived from fat, protein and carbohydrate was best achieved among respondents from higher social positions. The contribution of fat to total energy intake increased with decreasing socioeconomic grouping, a finding reflective of the higher consumption levels of foods high in fat by respondents from socially disadvantaged groups. Energy from carbohydrates was greatest among those from socially advantaged groups, and was close to the recommended 50% of the total energy intake. Conversely, energy from protein decreased with increasing social group. The overall contribution of the macronutrients to total energy intake appeared to be better balanced among higher social groups and reflects a greater consumption of foods recommended as health promoting. The pronounced variation in nutrient intake by socioeconomic factors reflects the findings of the few other studies that have investigated associations between social status factors and dietary behaviour. The Dutch-led investigation into social class variations in female fat and fibre consumption in three different localities in The Netherlands and Belgium found significant variation in fat similar to that by SLAN, that is, fat intakes higher in lower social class and lower education groups (Hupkens *et al*, 1997). Similarly, Norwegian adults with higher levels of education had lower levels of dietary fat intake (Johansson *et al*, 1997).

In terms of social support type indicators, the main observation was the recurring gender difference in the extent to which these indicators were associated with both food and nutrient intakes. Indicators such as marital status, number living in the household and to a lesser extent locality of dwelling, each showed gradients in nutrient intake, quite different for men and women, and while not as strong, were consistent with the variations found in the corresponding food intake (Friel *et al*, 2001). Living with someone, measured either through marriage or number of people living in the household, was positively associated with nutrient intake. As seen from the multivariate analyses, while overall the social status indicators explain only a very small part of the variance in energy derived from each macronutrient, socioeconomic factors account for more compared to the social support indicators. While most vitamins and minerals are within the daily RDAs, older people were lacking in vitamin D and older females were slightly deficient in iron.

Irish women's diets were more in accordance with dietary recommendations compared to men, a finding also observed in previous European studies (Anderson & Hunt, 1992; Abel & McQueen, 1994; Roos *et al*, 1998). Johansson *et al* (1997) showed differences in the intake of energy-yielding nutrients between Norwegian males and females and found that most nutrient intakes decreased with age, a pattern similar to that observed in the Irish data. Younger Slovenians, like younger Irish people, have diets higher in fat compared to their older counterparts (Koch & Pokorn, 1999). The mean intake of most nutrients, as with most foodstuffs, decreased with increasing age, with both males and females aged 65 years and over deficient in vitamin D when compared with the Irish RDAs (FSAI, 1999). As highlighted by Johansson *et al* (1997) from a survey into the dietary habits of Norwegian adults, elderly with low vitamin D levels are at risk from osteoporotic fractures. Iron levels were also below that recommended for females aged below 65 years.

A thorough validation of the SQFFQ used in the British arm of EPIC has been undertaken in several populations (Bingham *et al*, 1997) and likewise the adapted Irish version was validated using food diaries and urinary protein with PABA in staff and students of the National University of Ireland, Galway (Harrington, 1998). A Spearman's correlation of 0.40 was observed between the protein estimates using the food frequency and food diary and of 0.31 with the biomarker method. The relative validation of the food frequency and food diary estimates for total fat intake was 0.42 and 0.49 for saturated fats.

While valid and reliable assessment of individual nutrient intake is limited using the food frequency method, when undertaking large-scale population-based studies, food frequency questionnaires are the most practical and afford reliable estimation of aggregate differences between population groupings (Rimm *et al*, 1992; Willett, 1994; Johansson *et al*, 1997; Patterson *et al*, 1999; Subar *et al*, 2001). Recent discussion in the American Journal of Epidemiology highlights the complexity of interpretation of food frequency dietary data but does conclude that such measures do produce estimates that, to a large extent, reflect true nutrient intake (Byers, 2001).

This is not to say that caution should be abandoned in the interpretation of these proffered results and assume equal validity of intake data across the various population groups. Social desirability, differing ability to estimate frequency of consumption of foodstuffs and literacy levels may all contribute to misclassification of social groups. Social desirability bias can arise through the reliance on self-reported behaviour (Philips & Clancy, 1972) and such differences in the measurement of nutrient intake between the social status groupings could lead to differential misclassification and the interpretation that differences exist between groups, when in fact they do not. Herbert and colleagues highlighted the strong social and psychological influences on diet and dietary reporting (Hebert *et al*, 1995) and identified clear gender variation in such reporting biases, with males over-estimating their fat and energy intakes whereas women tended to underestimate (Hebert *et al*, 1997). A number of factors may influence such bias in dietary reporting, including nutritional knowledge, dieting and dietary beliefs. The pan-European survey of consumer attitudes to food, nutrition and health identified gender and education variations in the definition of healthy eating, with more females describing a healthy diet as one low in fat and those with tertiary level education more likely to mention a balanced diet (IEFS, 1996).

However, the level of energy reporting was determined by SLAN, but not reported in this paper, and the variation across each of the socioeconomic and social support type indicators measured. The finding that low-energy reporting was not more or less prevalent in most social groupings helps reinforce the confidence that the differences in nutrient intake are real. The results from SLAN SQFFQ compare favourably with those of the North/South Food Consumption Survey (IUNA, 2001). A comparison of the published mean total energy and energy derived from protein, fat and carbohydrate estimated using a 7-day record in the North/South Food Consumption Survey and those from the SQFFQ found levels of intake within two percentage energy points. The SQFFQ however appears to have underestimated the fat contribution to total energy intake compared to the 7-day food record. While this is not a validation of the food frequency method, the results are encouraging for the use of SQFFQ in large-scale population monitoring purposes.

Acknowledging that while indeed reporting bias is likely to exist, what these data are likely to reflect is social norms and therefore important in helping to understand the intention to change of different groups, hence aiding planning of targeted services. With little data previously existing in Ireland in terms of nutrient intake assessment across these social groupings, there is now the opportunity to rigorously assess such issues.

These cross-sectional surveillance data, while limited, clearly show inequalities in Irish dietary patterns. Recommended daily allowances are useful as guidelines for required nutrient intakes to maintain health and overall national mean intakes may inform whether the population in general is at risk or not. While most population subgroups in these analyses were above or within the general RDAs, it remains that there is much variability in the nutrient intake across the various strata. Although the variability in nutrient intake was less marked than that of food intake, this is possibly because of the contribution of differing food sources in the different social groups and must be borne in mind since important for educational and promotional purposes. Food-based guidelines would seem most appropriate in helping to reduce dietary inequalities and thus contribute to a reduction in the inequalities in health.

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