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Dietary fat intakes in Irish adults in 2011: how much has changed in 10 years?

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Abstract

Imbalances in dietary fat intakes are linked to several chronic diseases. This study describes dietary intakes and food sources of fat and fatty acids in 1051 Irish adults (aged 18–90 years), using data from the 2011 national food consumption survey, the National Adult Nutrition Survey. It also compares current intakes for 18–64-year-olds with those reported in the last such survey in 2001, the North/South Ireland Food Consumption Survey. Dietary fat intakes were estimated using data from 4-d semi-weighed (2011) and 7-d estimated (2001) food diaries. In 2011, intakes for 18–64-year-olds were as follows: total fat, 34.1 (SD 6.1) % total energy (%TE); SFA, 13.3 (SD 3.3) %TE; MUFA, 12.5 (SD 2.6) %TE; PUFA, 6.1 (SD 2.2) %TE; and *trans*-fat, 0.511 (SD 0.282) %TE. Apart from MUFA, intakes decreased ($P < 0.001$) compared with 2001. There was no statistically significant difference in intakes of EPA and DHA by 18–64-year-olds in 2011 (269.0 (SD 515.0) mg/d) and 2001 (279.1 (SD 497.5) mg/d). In 2011, adults aged >65 years had the highest intakes of SFA; however, intakes were typically higher than UK-recommended values for all groups. In contrast, intakes of long-chain *n*-3 fatty acids were lowest in younger age groups. Intakes of *trans*-fat were well within UK-recommended levels. Although there have been some improvements in the profile of intakes since 2001, imbalances persist in the quantity and quality of dietary fat consumed by Irish adults, most notably for total and SFA and for younger age groups for long-chain *n*-3 fatty acids.

Key words: Dietary fats: Fatty acid intakes: *n*-3 Fatty acids: SFA: *Trans*-fat

The macronutrient fat is an important source of energy in the diet in addition to being an essential component of cell membranes and precursor to signalling molecules⁽¹⁾. In 1950s, Keys *et al.* reported that a high-fat diet may lead to CHD and atherosclerosis^(2,3). Subsequent research has identified that imbalances in dietary fat intake are related to risk factors for a number of chronic diseases – for example, elevated intakes of SFA increase circulating LDL-cholesterol concentrations and risk of CVD⁽⁴⁾, whereas long-chain *n*-3 PUFA confer benefits to metabolic health⁽⁵⁾ and age-related functional decline⁽⁶⁾.

On the basis of such evidence, global, regional and national competent organisations or authorities have formulated dietary reference values (DRV) or recommendations to guide public health policy relating to total fat and each of fat type. Globally, the World Health Organization⁽⁷⁾ established recommendations for total fat intake of 15–35 % total energy (%TE), SFA of <10 %TE, *trans*-fat of <1 %TE and PUFA of 6–10 %TE. Broadly similar guidelines were set by the European Food Safety Authority (EFSA); however, they suggested that intakes of SFA and *trans*-fat should be as low as possible, and they have set a recommendation for EPA + DHA at 250 mg/d⁽⁸⁾. In addition, individual

countries such as the UK⁽⁹⁾, France⁽¹⁰⁾, USA⁽¹¹⁾, China⁽¹²⁾ and Japan⁽¹³⁾ have all set national guidelines.

Globally, national food consumption surveys facilitate the analysis of dietary fat intakes and allow monitoring of compliance with the aforementioned dietary guidelines using food intake data collected by a variety of methodologies^(14–19). Data from such surveys have typically indicated imbalances in the quality of dietary fat consumed (e.g. excessive intakes of total and/or SFA as reported recently for the UK and Finland)^(20,21). This has resulted in various public health education campaigns in Ireland and, for some dietary fats, industry initiatives' and government–industry partnerships to help consumers improve intake profiles such as reducing SFA^(22,23). The last national food consumption survey in Ireland (the North/South Ireland Food Consumption Survey (NSIFCS)⁽²⁴⁾) estimated intakes of total fat and SFA at 36 and 14 %TE, respectively, generally above those recommended⁽²⁵⁾. The National Adult Nutrition Survey (NANS)⁽²⁶⁾ was published 10 years later in 2011. The objective of the present study is to characterise dietary fat and fatty acid intakes in Irish adults in 2011 using comprehensive composition data. It will also compare current dietary fat intakes with those

Abbreviations: %TE; percentage of total energy; ALA; α -linolenic acid; EFSA; European Food Safety Authority; NANS; National Adult Nutrition Survey.

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reported in 2001 to characterise any changes that may have occurred in fat intakes in the intervening 10-year period.

Methods

Study populations

The analysis for this paper is based on data from two cross-sectional national food surveys of Irish adults: NANS and NSIFCS^(24,26). The NANS (2011) and the NSIFCS (2001) examined the habitual food and beverage consumption of representative samples of Irish adults during the periods 2008–2010 and 1997–1999, respectively (2011: *n* 1500, 740 men and 760 women aged 18–90 years; 2001: *n* 1379, 662 men and 717 women aged 18–64 years). The response rates were 60 and 63% in 2011 and 2001, respectively, with the high level of researcher–participant interaction helping maintain response rates and compliance in both surveys (three to four visits per participant over the survey periods). The sample sizes (1500 and 1379) were chosen to represent a population of over four million people and to deliver at least 100 individuals in the least populated age and sex subgroups. There were few exclusion criteria, other than pregnancy/lactation and inability to complete the survey because of disability. Analysis of both samples has shown them to be representative of the Irish adult population with respect to age, sex, social class and urban/rural location when compared with the relevant Irish censuses, as described by Irish Universities Nutrition Alliance in 2001 and 2011^(24,26). Both studies were conducted according to the guidelines laid down in the Declaration of Helsinki, with informed consent obtained from all subjects. All procedures involving human subjects were approved by relevant committees, with full details of the sampling procedures and study protocols described elsewhere^(27,28).

Food intake assessment

In 2011, food, beverage and supplement intake was determined using a 4-d semi-weighed food record recorded at brand level where possible. Participants were also asked to retain the packaging of all foods, beverages and supplements consumed. After quantification⁽²⁶⁾, initial energy and nutrient analysis was conducted using the Weighed Intake Software Program version 3.0 (Tinuviel Software), which uses data from McCance and Widdowson's *The Composition of Foods*, fifth and sixth editions plus all nine supplemental volumes to generate nutrient intake data, as described elsewhere⁽²⁶⁾. If necessary, adjustments were made to account for recipes, nutritional supplements, commonly consumed generic Irish foods and new foods to the market. The final food consumption database was initially examined to identify those foods/drinks containing fat. Accompanying databases were created for recipes and for food supplements at brand level. In contrast, the 2001 survey assessed food and nutrient intake using a 7-d estimated food record⁽²⁴⁾. Although the recording methods differed slightly, similar protocols were followed regarding quantification and assessment of nutrient intakes⁽²⁴⁾, with a description of intakes of dietary fatty acids over the 7-d period described

elsewhere^(25,29). The current paper aimed to compare intakes of dietary fat between 2001 and 2011. However, as the dietary records of 2001 were based on a 7-d estimated food record, the 2001 data were re-allocated from 7-d food record to 4-d food record, and the bootstrap method was used to enable a more direct comparison with the data from 2011^(21,30). This was carried out by re-sampling 100 independent randomisations using the bootstrap method, and parameter estimates were averaged over 100 bootstrap samples.

Estimation of dietary fat composition of foods

Methodologies used to calculate the dietary fat composition of foods and recipes consumed in 2001 have previously been described^(25,29). A similar protocol was followed for foods and recipes consumed in 2011. First, an SPSS database was created containing all of the foods consumed, including recipes. Each food item in this database was linked to the original consumption database using a unique food code. Each food code was then examined and assigned a fatty acid concentration for total fat, SFA, MUFA, PUFA, α -linolenic acid (ALA), EPA, DHA and *trans*-fat (g/100 g) based on published food composition tables^(31–33), published papers^(25,29), the packaging information collected during NANS and with updated industry data included where available. Published values were used for EPA and DHA contents of milk and milk products and some meats, as values are typically absent from food composition tables despite being present in low concentrations in these commonly consumed foods⁽²⁹⁾. A similar approach was adopted for the recipe database whereby the fatty acid composition was obtained for each ingredient as described above and the values were aggregated before re-introduction into main databases.

Calculating fatty acid intakes of Irish adults

The total fat, SFA, MUFA, PUFA, EPA, DHA and *trans*-fat contents (g/100 g product) were available for *n* 2552 foods and recipes in 2011 and 2938 in 2001. ALA intakes were estimated only in 2011; they were not available for 2001. All entries were double-checked by the researcher, and a random sample was checked by another researcher in-house to minimise the chance of error. To represent the actual amount of fatty acid consumed, each fatty acid concentration in the database was converted from g/100 g food to grams per actual weight of food consumed. Information from this database was then used to calculate the mean daily intake of each fatty acid per person per day.

Data analysis

Under-reporters of energy intake (20–30% of total populations) were identified as having a ratio of energy intake:BMR of $<1.05^{(34)}$ and were excluded in this analysis; hence, the final sample sizes were 1051 (2011) and 1097 (2001) individuals. Data were analysed using SPSS version 20 (SPSS Inc.). The mean values and standard deviations of total fat, SFA, MUFA, PUFA, ALA, EPA, DHA and *trans*-fat intakes (g/d and as %TE) were calculated for the total population in 2011 by sex and age group (18–35, 36–50, 51–64 and over 65 years). To calculate

compliance levels for *trans*-fat, intakes were expressed as percentage contribution to food energy (%FE; energy content from alcohol was excluded as per relevant recommendation). When examined, the data for individual fatty acid intakes are skewed, but because of the large sample size parametric tests are allowed to be applied (based on the central limit theorem). Differences in fat intake accounting for age, survey and sex were detected either using independent *t* tests, one-way ANOVA (age group) or a two-way ANOVA (age and survey) as appropriate. *P* values are presented uncorrected for multiple testing, because of the high expected correlation of the tests. We encourage readers to examine the effect sizes presented, and furthermore we note which results would survive a conservative Bonferroni correction. Foods consumed in 2011 and 2001 were aggregated into twenty-two different food categories, and the percentage contribution from each food group to total fatty acid intake was calculated as population proportions⁽³⁵⁾. As there are no national dietary guidelines for Ireland, compliance with the dietary guidelines from the UK^(9,36) and EFSA⁽⁸⁾ (for EPA+DHA) was assessed by estimating the maximal size of subgroup of 'compliers' who met the population target⁽³⁷⁾. Briefly, this method involves ranking individual mean daily intakes from lowest to highest. For the % TE from total fat and SFA recommendations, the mean intake of the compliers group was calculated by starting with the individual with the lowest mean %TE from fat (or SFA) and including successive individuals until the addition of one more subject led to the average intake of the group to exceed the DRV⁽³⁷⁾. The same approach was used for MUFA, PUFA and EPA+DHA, except that mean daily intakes for each individual were ranked in descending order from highest to lowest and successive individuals added until the addition of the next individual caused the group mean to fall below the population target. The percentage of adults who were 'compliers' with each recommendation was then calculated.

Results

The final NANS sample comprised 49.8% men and 50.2% women and included 65.2, 19.4 and 15.4% in the age groups 18–50, 51–64 and ≥65 years, respectively. The majority of the sample comprised individuals from an urban location (68.9%), and almost half (46.1%) of them were classified as professionals or in technical or managerial occupations. The final sample was representative of the Irish population in terms of age, sex, education level and location⁽³⁸⁾. The demographic characteristics of the NSIFCS have been described in detail elsewhere and were also representative of the Irish population at that time⁽³⁹⁾. The mean energy intakes were 9347 (SD 2623) kJ (2234 (SD 627) kcal) and 10 192 (SD 2987) kJ (2436 (SD 714) kcal) in 2010 and 2001, respectively.

Mean daily intake of dietary fat in 2011 and 2001 by age and sex

Tables 1–4 present the mean daily intakes of dietary fat in g/d and as %TE in Irish adults, by age and sex in 2011 with

comparison with 2001 as relevant. In 2011, intake of total fat (%TE) was 34.1 (SD 6.1)% for adults aged 18–64 years and 34.9 (SD 6.9)% for those aged more than 65 years ($P=0.136$), with intakes higher ($P<0.001$) in women aged 18–64 years (34.9 (SD 5.9)%) than in men (33.3 (SD 6.2)%). Compared with 2001 (35.7 (SD 5.9)%TE), lower intakes of total fat were observed in 2011 for 18–64-year-olds and for men and women of all age categories ($P<0.001$) (Tables 3 and 4). In 2011, dietary intakes (%TE) of SFA in the total population were 13.3 (SD 3.3)% for 18–64-year-olds, with higher ($P=0.003$) intakes for those aged more than 65 years (14.3 (SD 4.1)%). A similar pattern emerged whereby higher intakes of SFA (%TE) were recorded in 2001 than in 2011 for the total population aged 18–64 years (13.9 (SD 3.4) *v.* 13.3 (SD 3.3)%, $P<0.001$) and for men and women of all ages, except men aged 51–64 years where a slight increase was observed. However, after Bonferroni correction (for fourteen to sixteen tests), only significant differences in SFA intakes (%TE) between 2011 and 2001 for the total population and for women aged 18–64 years remained significant at a family-wise type I error rate of 5%. In 2011, intakes (%TE) of MUFA were 12.5 (SD 2.6) and 12.2 (SD 2.9)% for adults aged 18–64 years and over 65 years, respectively. Higher ($P=0.017$) intakes were observed for women (12.7 (SD 2.6)%) aged 18–64 years compared with men (12.3 (SD 2.7)%), but intakes were higher ($P\leq 0.002$) in all population groups in 2011 than in 2001. In 2011, intakes of PUFA (%TE) were 6.1 (SD 2.2)% for 18–64 years and 5.9 (SD 2.5)% for over 65 years in the total population. Intakes of PUFA were higher in women than in men ($P\leq 0.027$), but with lower intakes in 2011 than 2001 for all population groups ($P<0.001$). After Bonferroni correction (for sixteen tests), only differences in PUFA intakes between the 2 time points remained significant at a family-wise type I error rate of 5%.

In 2011, ALA intakes (%TE) were 0.60 (SD 0.39)% for those aged 18–64 years and 0.59 (SD 0.76)% for those aged more than 65 years in the total population, with intakes significantly higher in women than in men in both age categories ($P<0.027$). In 2011, the mean daily intakes of EPA and DHA from food and supplements (mg/d) were 113 (SD 244.3) and 156 (SD 284.3) mg/d for adults aged 18–64 years, respectively, with significantly higher ($P<0.001$) intakes observed in adults aged over 65 years (187.9 (SD 261.1) and 247.7 (SD 300.5) mg/d, respectively). There was no difference in intakes between the surveys; however, in both instances the lowest intakes were observed for men and women aged 18–35 years. In 2011, combined intakes of EPA and DHA for men and women aged 18–35 years were 160.3 (SD 240.4) and 201.8 (SD 299.3) mg/d. Significantly ($P<0.001$) higher intakes were reported for supplement users than non-users in 2011, but not in 2001 ($P>0.001$, see online Supplementary Table S1). The contribution (%) of *trans*-fat intake to total energy intake was 0.51 (SD 0.28)% for adults aged 18–64 years and 0.56 (SD 0.36)% for adults aged more than 65 years. Intakes of *trans*-fat (%TE) were slightly higher in men than in women aged 18–64 years (0.53 (SD 0.30) *v.* 0.49 (SD 0.26)%, $P=0.039$) and in 2001 than in 2011 (0.69 (SD 0.25) *v.* 0.51 (SD 0.28)%, $P<0.001$). After Bonferroni correction (for sixteen tests), only differences in *trans*-fat intakes between the 2 time points remained significant at a family-wise type I error rate of 5%.



Table 1. Intakes of total fat (g/d and percentage of total energy (%TE)) and its constituent fatty acids in Irish adults in 2011 (Mean values and standard deviations)

	2011														
	Total population					Male		Female			Male		Female		
	18–64 years (n 889)		≥65 years (n 162)			18–64 years (n 448)		18–64 years (n 441)			≥65 years (n 75)		≥65 years (n 87)		
	Mean	SD	Mean	SD	<i>P</i> *	Mean	SD	Mean	SD	<i>P</i> †	Mean	SD	Mean	SD	<i>P</i> ‡
Total fat (g/d)	86.8	27.9	74.3	29.3	<0.001	98.6	28.9	74.9	20.8	<0.001	84.5	35.1	65.5	19.5	<0.001
SFA (g/d)	33.9	12.4	30.7	14.9	0.004	38.7	13.0	28.9	9.4	<0.001	35.6	17.9	26.5	10.0	<0.001
MUFA (g/d)	31.9	11.1	26.0	10.6	<0.001	36.4	11.5	27.4	8.5	<0.001	29.8	12.3	22.6	7.5	<0.001
PUFA (g/d)	15.4	6.8	12.4	5.9	<0.001	16.9	7.5	13.9	5.5	<0.001	13.1	6.2	11.7	5.6	0.137
ALA (g/d)	1.5	0.9	1.2	1.6	0.002	1.7	1.0	1.4	0.9	<0.001	1.1	0.6	1.3	2.1	0.350
EPA (mg/d)	113.4	244.3	187.9	261.1	<0.001	125.0	306.1	101.7	158.1	0.154	184.2	222.6	191.2	291.5	0.865
DHA (mg/d)	155.6	284.3	247.7	300.5	<0.001	162.9	329.3	148.2	229.8	0.442	265.8	314.4	232.2	289.0	0.480
Trans-fat (g/d)	1.3	0.9	1.2	0.9	0.135	1.6	1.0	1.1	0.6	<0.001	1.4	1.1	1.0	0.7	0.009
Total fat (%TE)	34.1	6.1	34.9	6.9	0.136	33.3	6.2	34.9	5.9	<0.001	34.7	7.3	35.1	6.6	0.693
SFA (%TE)	13.3	3.3	14.3	4.1	0.003	13.1	3.2	13.5	3.3	0.052	14.5	4.4	14.2	4.0	0.606
MUFA (%TE)	12.5	2.6	12.2	2.9	0.153	12.3	2.7	12.7	2.6	0.017	12.3	3.0	12.1	2.8	0.719
PUFA (%TE)	6.1	2.2	5.9	2.5	0.375	5.7	2.1	6.5	2.3	<0.001	5.4	1.8	6.3	3.0	0.027
ALA (%TE)	0.60	0.39	0.59	0.76	0.724	0.56	0.38	0.64	0.39	0.002	0.46	0.19	0.70	1.01	0.027
EPA (%TE)	0.046	0.091	0.093	0.126	<0.001	0.044	0.103	0.048	0.076	0.445	0.080	0.105	0.103	0.141	0.255
DHA (%TE)	0.064	0.114	0.124	0.151	<0.001	0.057	0.115	0.070	0.112	0.075	0.114	0.138	0.131	0.161	0.478
Trans-fat (%TE)	0.511	0.282	0.558	0.360	0.116	0.530	0.304	0.491	0.256	0.039	0.567	0.373	0.550	0.351	0.777

n, Number of participants; ALA, α-linolenic acid.

* Independent samples *t* test for comparison of means between age groups.

† Independent samples *t* test for comparison of means between sex.

‡ Independent samples *t* test for comparison of means between National Adult Nutrition Survey and North/South Ireland Food Consumption Survey.

Table 2. Intakes of total fat (g/d and percentage of total energy (%TE)) and its constituent fatty acids in Irish adults in 2001 (Mean values and standard deviations)

	2001								
	Total population			Male			Female		
	18–64 years (n 1097)			18–64 years (n 555)			18–64 years (n 542)		
	Mean	SD	P*	Mean	SD	P†	Mean	SD	P‡
Total fat (g/d)	96.7	32.8	<0.001	111.2	34.1	<0.001	81.8	23.6	<0.001
SFA (g/d)	37.9	15.4	<0.001	43.7	16.6	<0.001	32.0	11.3	<0.001
MUFA (g/d)	32.4	11.5	0.372	37.5	11.8	0.142	27.2	8.4	0.669
PUFA (g/d)	18.9	7.9	<0.001	21.5	8.6	<0.001	16.4	6.2	<0.001
ALA (g/d)	—	—	—	—	—	—	—	—	—
EPA (mg/d)	124.3	234.7	0.314	125.5	223.1	0.977	123.1	246.2	0.099
DHA (mg/d)	154.8	265.4	0.952	160.5	257.1	0.898	149.1	273.7	0.958
Trans-fat (g/d)	1.9	0.9	<0.001	2.1	1.0	<0.001	1.6	0.7	<0.001
Total fat (%TE)	35.7	5.9	<0.001	35.0	6.0	<0.001	36.4	5.7	<0.001
SFA (%TE)	13.9	3.4	<0.001	13.7	3.4	0.005	14.2	3.4	0.002
MUFA (%TE)	11.9	2.2	<0.001	11.8	2.3	0.002	12.1	2.2	<0.001
PUFA (%TE)	7.1	2.3	<0.001	6.8	2.2	<0.001	7.3	2.3	<0.001
ALA (%TE)	—	—	—	—	—	—	—	—	—
EPA (%TE)	0.049	0.098	0.497	0.042	0.078	0.744	0.056	0.114	0.200
DHA (%TE)	0.061	0.110	0.562	0.053	0.089	0.595	0.068	0.128	0.762
Trans-fat (%TE)	0.686	0.253	<0.001	0.673	0.255	<0.001	0.698	0.250	<0.001

n, Number of participants; ALA, α -linolenic acid; —, data not available.

* Independent samples *t* test for comparison of means between age groups.

† Independent samples *t* test for comparison of means between sex.

‡ Independent samples *t* test for comparison of means between National Adult Nutrition Survey and North/South Ireland Food Consumption Survey.

Table 3. Intakes of total fat (g/d and percentage of total energy (%TE)) and its constituent fatty acids in Irish men in 2011 and 2001 by age group (Mean values and standard deviations)

	2011						2001						Two-way ANOVA		
	18–35 years (<i>n</i> 207)		36–50 years (<i>n</i> 143)		51–64 years (<i>n</i> 98)		18–35 years (<i>n</i> 218)		36–50 years (<i>n</i> 198)		51–64 years (<i>n</i> 139)				
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	A	S	A × S
Total fat (g/d)	102.4	27.9	96.8	30.1	93.4	28.7	116.8	34.5	113.3	34.2	99.4	30.5	<0.001	<0.001	0.128
SFA (g/d)	39.5	13.2	38.6	12.4	37.4	13.5	45.6	16.5	45.0	17.3	38.9	14.6	0.001	<0.001	0.099
MUFA (g/d)	38.3	11.0	35.6	12.6	33.6	10.2	39.7	12.3	37.7	11.5	33.7	10.5	<0.001	0.109	0.582
PUFA (g/d)	17.9	6.6	16.2	7.6	15.9	8.9	23.1	8.7	21.6	8.3	18.8	8.3	<0.001	<0.001	0.139
ALA (g/d)	1.8	0.7	1.6	1.4	1.5	0.9	—	—	—	—	—	—	0.041	—	—
EPA (mg/d)	86.4	135.7	113.5	196.8	223.4	568.1	92.9	148.4	137.0	240.2	160.3	282.4	<0.001	0.519	0.133
DHA (mg/d)	115.4	177.1	149.7	268.4	282.2	555.3	124.4	184.4	174.2	276.0	197.5	315.4	<0.001	0.367	0.064
<i>Trans</i> -fat (g/d)	1.7	1.1	1.5	0.8	1.5	1.0	2.1	1.0	2.3	1.1	2.0	0.9	0.057	<0.001	0.082
Total fat (%TE)	32.7	6.2	33.8	5.8	33.8	6.8	35.0	5.7	35.5	6.0	34.1	6.2	0.158	<0.001	0.118
SFA (%TE)	12.6	3.2	13.5	3.0	13.5	3.4	13.6	3.2	14.0	3.5	13.3	3.6	0.026	0.047	0.067
MUFA (%TE)	12.3	2.7	12.4	2.6	12.2	2.8	11.9	2.2	11.8	2.2	11.6	2.4	0.575	0.001	0.723
PUFA (%TE)	5.7	1.9	5.7	2.1	5.7	2.7	7.0	2.2	6.9	2.3	6.4	2.2	0.296	<0.001	0.224
ALA (%TE)	0.57	0.20	0.58	0.59	0.52	0.25	—	—	—	—	—	—	0.41	—	—
EPA (%TE)	0.028	0.043	0.041	0.076	0.081	0.186	0.028	0.046	0.045	0.082	0.058	0.104	<0.001	0.296	0.155
DHA (%TE)	0.037	0.058	0.053	0.103	0.104	0.188	0.039	0.058	0.057	0.093	0.071	0.117	<0.001	0.169	0.068
<i>Trans</i> -fat (%TE)	0.533	0.321	0.529	0.276	0.526	0.310	0.639	0.228	0.709	0.268	0.676	0.271	0.267	<0.001	0.186

n, Number of participants; A, age; S, survey; ALA, α -linolenic acid; —, data not available.

The percentage of Irish adults adhering to different dietary fat recommendations

The percentage of Irish adults adhering to dietary recommendations of the UK Department of Health⁽⁹⁾ for total fat, SFA and MUFA, EFSA recommendations for ALA, EPA and DHA⁽⁸⁾, and UK Scientific Advisory Committee on Nutrition (SACN)⁽³⁶⁾ recommendations for *trans*-fat in 2011 is presented in Table 5.

High levels of compliance were noted for adults aged 18–64 years and those aged over 65 years for total fat (94, 86%), MUFA (100, 100%), PUFA (100, 98%), ALA (100, 100%) and *trans*-fat (100, 100%). By examining intakes from supplements and foods, high levels of compliance were observed for adults aged 18–64 and >65 years for EPA and DHA (100, 100%). Lower rates of compliance were observed when intakes from food only were assessed, with the lowest levels of compliance

Table 4. Intakes of total fat (g/d and percentage of total energy (%TE)) and its constituent fatty acids in Irish women in 2011 and 2001 by age group (Mean values and standard deviations)

	2011						2001						Two-way ANOVA		
	18–35 years (<i>n</i> 170)		36–50 years (<i>n</i> 165)		51–64 years (<i>n</i> 106)		18–35 years (<i>n</i> 206)		36–50 years (<i>n</i> 224)		51–64 years (<i>n</i> 112)				
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	A	S	A × S
Total fat (g/d)	78.7	22.9	72.8	19.5	71.9	18.6	82.7	23.2	82.7	24.1	78.4	23.2	0.011	<0.001	0.190
SFA (g/d)	29.9	9.8	28.6	9.3	27.9	8.9	32.3	11.3	31.9	11.3	31.3	11.5	0.228	<0.001	0.814
MUFA (g/d)	29.4	9.2	26.4	7.8	25.8	7.6	27.5	8.0	27.6	8.9	25.8	7.8	0.001	0.669	0.040
PUFA (g/d)	14.8	5.8	13.2	5.0	13.5	5.7	16.9	6.3	16.6	6.0	14.9	6.1	0.004	<0.001	0.091
ALA (g/d)	1.4	0.7	1.3	1.0	1.4	0.8	—	—	—	—	—	—	0.768	—	—
EPA (mg/d)	62.9	100.7	104.7	157.4	159.1	209.5	79.9	181.9	119.0	231.5	210.6	339.8	<0.001	0.045	0.529
DHA (mg/d)	97.5	148.4	156.9	236.4	216.0	299.4	102.1	202.5	144.1	262.3	245.3	371.1	<0.001	0.671	0.613
Trans-fat (g/d)	1.1	0.6	1.0	0.5	1.0	0.6	1.6	0.7	1.6	0.7	1.6	0.8	0.772	<0.001	0.783
Total fat (%TE)	35.0	5.7	34.9	6.1	34.6	6.1	36.6	5.3	36.6	5.9	35.6	6.1	0.305	<0.001	0.739
SFA (%TE)	13.3	3.1	13.7	3.3	13.5	3.6	14.3	3.5	14.1	3.3	14.1	3.4	0.943	0.003	0.512
MUFA (%TE)	13.0	2.5	12.6	2.5	12.4	2.7	12.1	1.9	12.2	2.4	11.7	2.3	0.029	<0.001	0.461
PUFA (%TE)	6.5	1.9	6.4	2.5	6.5	2.4	7.5	2.3	7.4	2.3	6.8	2.3	0.120	<0.001	0.116
ALA (%TE)	0.63	0.29	0.65	0.49	0.65	0.36	—	—	—	—	—	—	0.858	—	—
EPA (%TE)	0.027	0.044	0.051	0.080	0.076	0.099	0.036	0.082	0.054	0.107	0.096	0.160	<0.001	0.103	0.563
DHA (%TE)	0.043	0.065	0.077	0.120	0.103	0.144	0.046	0.091	0.066	0.124	0.113	0.175	<0.001	0.960	0.521
Trans-fat (%TE)	0.485	0.245	0.488	0.245	0.506	0.290	0.693	0.252	0.696	0.242	0.712	0.264	0.618	<0.001	0.999

n, Number of participants; A, age; S, survey; ALA, α -linolenic acid; —, data not available.

for men (58 %) and women (47 %) aged 18–35 years. Relatively low levels of compliance persisted for SFA (36 and 30 %TE in 18–64-year-olds and >65-year-olds, respectively), with the lowest levels of compliance observed for men and women aged 36–50 years (27 and 30 %) and men aged >65 years (27 %). By comparison, the proportions of adults aged 18–64 years meeting the recommendations were higher in 2011 than in 2001 for all dietary fats and for all population groups, except for EPA and DHA (see online Supplementary Table S2).

Percentage contribution of food groups to dietary fat in 2011 and 2001

The percentage contribution of food groups to dietary fat in 2011 and 2001 are presented in Tables 6 and 7. 'Fresh meat' made the greatest contribution to total fat, SFA and MUFA in both 2011 and 2001, followed by 'meat products', 'biscuits, cakes, pastries and buns' and 'spreading fats and oils'. Whole milk featured more strongly as a contributor to SFA intakes in 2001 than in 2011. In 2011, the main contributors to PUFA were 'meat products' and 'potatoes chipped, fried and roasted', whereas in 2001 the major contributors were 'spreading fats and oils' and 'potatoes chipped, fried and roasted'. 'Meat dishes' and 'spreading fats and oils' were the greatest contributors to ALA intake in 2011 (Table 7). The major food sources of EPA and DHA were 'fish, fish products and fish dishes' and 'fresh meat' in both 2011 and 2001. Unsurprisingly, 'nutritional supplements' featured as a contributor to EPA and DHA when intakes from food supplements were included in the estimation of intakes. The main contributors to *trans*-fat were 'cheeses', 'fresh meat', 'meat dishes' and 'whole milk' in 2011, whereas in 2001 they were 'cheeses', 'fresh meat' and 'butter'.

Discussion

Over the decade 2001–2011, improvements in the profile of dietary fats consumed by Irish adults have been observed. However, imbalances in dietary fat quality remain whereby intakes of SFA were higher for all population groups than recommended and with the lowest intakes of long-chain *n*-3 PUFA for young men and women. Population intakes of *trans*-fat were within recommended levels. This analysis shows that in 2011 population intakes of total fat (both g/d and %TE), SFA (both g/d and %TE), PUFA (both g/d and %TE) and *trans*-fat (both g/d and %TE) decreased compared with the previous national food survey in 2001; intakes of MUFA (%TE) increased, whereas no change was evident for EPA and DHA.

Intakes of SFA (13 %TE) by Irish adults in 2011 agree with those reported in other EU countries such as France, Finland or the UK (12–15 %TE)^(8,40), albeit higher compared with other global regions such as North and South America, Asia and Africa where intakes can lie ≤ 10 %TE^(14,15,41). Although a slight reduction of 0.6 % ($P < 0.001$) in mean daily intakes has occurred in Ireland since 2001, average intakes of SFA in Ireland continue to deviate from such numerical guidelines of about 10 %TE⁽⁹⁾ and from the EFSA guideline of 'as low as possible'⁽⁸⁾. This poses challenges, as despite public health education campaigns and initiatives by the food industry and regulators all population groups were affected, with the lowest levels of compliance (<29 %) with the <10 %TE recommendation⁽⁹⁾ by older men aged >65 years and men and women aged 36–50 years. Currently, the major food sources of SFA continue to be fresh meats, whole milk and cheeses, as well as meat products and 'biscuits, cakes, pastries and buns', which together contribute 40 % to SFA intakes, similar to that reported for other European countries^(21,42). Collectively, reductions in the

Table 5. Percentage of Irish adults adhering to current UK, European Food Safety Authority and WHO/FAO dietary recommendation for total fat and fatty acids by age group and sex in 2011

	Total population										Male					Female				
	18–35 years (n 377)	36–50 years (n 308)	51–64 years (n 204)	18–64 years (n 889)	≥65 years (n 162)	18–35 years (n 207)	36–50 years (n 143)	51–64 years (n 98)	18–64 years (n 448)	≥65 years (n 75)	18–35 years (n 170)	36–50 years (n 165)	51–64 years (n 106)	18–64 years (n 441)	≥65 years (n 87)					
Total fat ≤33% TE*	94.2	88.0	90.2	91.3	85.8	100.0	93.0	94.9	98.2	89.3	80.0	83.0	84.9	82.8	82.8					
SFA ≤10% TE*	41.4	28.2	35.3	35.5	30.2	48.3	26.6	31.6	38.2	26.7	32.4	29.7	37.7	32.9	32.2					
MUFA ≥12% TE*	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0					
PUFA ≥6% TE*	100.0	100.0	100.0	100.0	97.5	90.3	86.7	91.8	90.0	78.7	100.0	100.0	100.0	100.0	100.0					
ALA 0.5% TE†	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	81.3	100.0	100.0	100.0	100.0	100.0					
EPA + DHA > 250 mg†																				
Food + supplements	69.5	100.0	100.0	100.0	100.0	78.7	100.0	100.0	100.0	100.0	58.8	100.0	100.0	99.8	100.0					
Food only‡	53.6	95.4	100.0	85.1	100.0	57.7	88.4	100.0	88.8	100.0	47.1	100.0	100.0	81.3	100.0					
Trans-fat ≤2% FE§	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0					

n, Number of participants; %TE, percentage of total energy; ALA, α-linolenic acid; %FE, percentage contribution to food energy.

* Dietary reference values of UK Department of Health⁽⁶⁾.

† Targets for total fat, ALA, EPA and DHA are from the dietary reference values of European Food Safety Authority⁽⁶⁾.

‡ Sample sizes for intakes of EPA + DHA from foods only for 18–35, 36–50, 51–64 and ≥65 years were 336, 280, 162, 778, 132 for total population; 183, 129, eighty-one, 393, sixty-two for men; 153, 151, eighty-one, 385, seventy for women.

§ Targets for trans-fat are from UK SACN⁽³⁶⁾.

contributions of whole milk and butter to SFA intakes in adults aged 18–64 years (by approximately –6% from 2001) may reflect public health messages^(23,43) to choose lower-fat options; however, butter remains a greater contributor for older (8.4%) than younger (5.3%) adults. Hence, intakes of SFA continue to deviate from current guidance in Ireland. However, this combination of foods contributing to SFA intakes is noteworthy (e.g. milks, meats, biscuits and cakes). Consideration of these differing foods may now be merited in any future dietary guidelines given the growing body of evidence, which suggests differential effects of SFA on health depending on the food form in which they occur⁽⁴⁴⁾.

In this study, intakes of *trans*-fat have decreased by approximately 0.2% energy in the decade from 2001 to 2011 and, at 0.5%TE (0.5%FE), are well below the UK SACN⁽³⁶⁾ recommendation of ≤2%FE, similar to that reported for Finland (0.4%TE)⁽²⁰⁾, albeit slightly lower than that reported for the UK (0.8%FE)⁽²¹⁾. The major dietary sources of *trans*-fat in the Irish adult diet are now ruminant animal products such as meat, cheese and whole milk (42% contribution), with decreases observed for foods such as 'spreading fats and oils' (from 5.9 to 1.4% intakes). This is significant given that intakes of *trans*-fats from animal sources have not been related to CHD events⁽⁴¹⁾ in contrast to those from industrial sources⁽⁴²⁾. It also suggests that commercial foods containing artificial *trans*-fats are no longer on sale, or at least are no longer consumed to a significant degree, in Ireland.

In general, mean daily intakes of EPA and DHA (269 mg/d) in Irish adults from food and supplements met the EFSA-recommended adequate intake (AI) of ≥250 mg/d⁽⁸⁾. Mean daily intakes from food and supplements reported here were in line with mean values published for a sample of Belgian women (276 mg/d)⁽⁴⁵⁾, with median values (range 71–228 mg/d) broadly comparable with published median intakes for a representative sample of Belgian adults⁽⁴⁶⁾. However, median values were higher than those observed for the Dutch National Food Survey depending on age and sex⁽⁴⁷⁾. Intakes from food alone were marginally higher in Irish adults; this is perhaps because of the methodology used here, which factored for *n*-3 content of milks and some meats⁽²⁹⁾. Nevertheless, a distribution of intakes was evident in Irish adults, whereby the highest mean daily intakes from all sources were recorded for adults aged >65 years (436 (SD 542) mg/d) and the lowest intakes for men (202 (SD 299) mg/d) and women (161 (SD 240) mg/d) aged 18–35 years. Given the beneficial role of these fatty acids for cardiovascular health and particularly during pregnancy and lactation (where EFSA recommend increasing intakes of DHA by an additional 100–200 mg/d⁽⁸⁾), such low intakes by younger subgroups may have implications for longer-term health. Among consumers, supplements contributed up to 55% of total EPA + DHA intake. Furthermore, the use of *n*-3 supplements was higher in 2011 (12.5%) than in 2001 (7.5%) for all (see online Supplementary Table S2). Upon exclusion of supplement users, levels of compliance with the recommended AI of ≥250 mg/d⁽⁸⁾ dropped to 85% of the total population, with lowest compliance (47%) for female non-supplement users aged 18–35 years. Unsurprisingly, 'fish, fish products and fish dishes' and 'fresh meat' were the main food contributors in the population, which



Table 6. Percentage contribution of food groups to total fat, SFA, MUFA and PUFA in Irish adults in 2011 and 2001 (excluding contribution from supplements)

	Total fat			SFA			MUFA			PUFA		
	2011		2001	2011		2001	2011		2001	2011		2001
	18–64 years (n 889)	≥65 years (n 162)	18–64 years (n 1097)	18–64 years (n 889)	≥65 years (n 162)	18–64 years (n 1097)	18–64 years (n 889)	≥65 years (n 162)	18–64 years (n 1097)	18–64 years (n 889)	≥65 years (n 162)	18–64 years (n 1097)
Fresh meat	9.1	13.0	9.9	8.7	12.3	9.7	10.7	15.6	12.6	7.5	11.2	6.8
Meat products	8.4	6.1	7.2	7.5	5.6	7.0	10.2	7.6	8.8	8.2	6.2	5.4
Meat dishes	4.7	4.3	4.9	4.9	4.7	4.3	5.0	3.7	5.4	3.6	3.7	4.3
Fish, fish products and fish dishes	3.0	5.1	3.1	1.6	2.7	1.7	3.3	5.9	3.6	4.7	8.3	4.7
Egg and egg dishes	2.9	3.1	2.6	2.5	2.4	2.1	3.3	3.8	3.1	2.2	2.6	1.9
Spreading fats and oils	8.4	12.1	11.5	8.1	10.0	8.8	8.9	12.8	9.7	10.1	17.1	20.8
Butter	3.4	6.2	5.2	5.3	8.4	7.8	2.4	4.8	4.0	0.8	2.1	1.3
Potatoes chipped, fried and roasted	5.4	2.6	5.9	3.3	1.5	3.5	6.3	3.2	6.8	8.1	3.8	10.1
Potato products	1.0	0.5	0.8	0.5	0.2	0.5	0.7	0.4	0.6	2.4	1.6	1.9
Potatoes	0.8	1.2	1.2	1.1	1.5	1.2	0.5	0.8	0.7	0.9	1.3	2.2
Breads and rolls	5.3	5.8	4.9	4.8	4.7	3.7	3.5	4.1	3.8	5.8	7.5	7.0
Biscuits, cakes, pastries and buns	7.1	7.4	7.1	8.3	8.3	8.2	7.3	7.8	7.5	5.5	6.1	4.3
Sugars, confectionery and preserves	4.1	1.6	3.6	5.9	2.3	4.9	4.1	1.6	3.8	1.5	0.7	1.1
Puddings and chilled desserts	2.1	3.3	3.0	3.1	4.8	3.8	1.8	2.9	2.9	1.0	1.5	1.4
Ice cream and cream	1.3	1.8	1.7	2.2	2.8	2.7	0.9	1.2	1.4	0.3	0.3	0.4
Cheeses	5.1	4.2	4.3	8.0	6.2	6.8	4.0	3.5	3.7	1.5	1.3	1.0
Whole milk	4.6	4.3	6.5	7.0	6.3	10.2	3.3	3.3	5.8	0.8	0.8	1.0
Low-fat, skimmed and fortified milk	1.7	2.7	1.6	2.7	4.2	2.7	1.5	2.5	1.5	0.0	0.0	0.0
Savouries (e.g. pizza, quiche)	3.8	1.2	2.7	3.9	1.1	2.4	3.9	1.3	3.1	3.5	1.3	3.3
Savoury snacks (e.g. crisps)	2.6	0.3	2.2	1.0	0.1	2.2	3.1	0.3	2.6	5.9	0.7	2.0
Vegetable and pulse dishes	2.8	1.9	2.5	1.5	1.2	1.2	2.5	1.9	2.0	5.9	3.1	5.8
Nuts and seeds, herbs and spices	1.9	1.1	0.7	0.9	0.4	0.3	2.2	1.0	0.9	3.4	2.4	1.2
Soups, sauces and miscellaneous foods	4.9	3.2	3.6	2.6	2.2	2.2	6.0	3.7	3.1	7.6	5.4	6.4
RTEBC	1.0	0.8	0.7	0.6	0.5	0.4	1.0	0.8	0.5	1.7	1.5	1.2
Others*	4.7	6.2	2.5	4.0	5.4	1.6	3.5	4.7	1.9	7.3	9.1	4.4

n, Number of participants; RTEBC, ready-to-eat breakfast cereals.

* Other food groups include rice, pasta, flours, grains, other breakfast cereals, non-alcoholic beverages, nuts and seeds, herbs and spices, fruit, vegetables, other milk and milk-based beverages.

Dietary fat intakes in Irish adults

Table 7. Percentage contribution of food groups to α -linolenic acid (ALA), EPA, DHA and *trans*-fat intakes in Irish adults in 2011 and 2001 (excluding contribution from supplements)

	ALA			EPA			DHA			<i>Trans</i> -fat		
	2011		2001	2011		2001	2011		2001	2011		2001
	18–64 years (<i>n</i> 889)	≥65 years (<i>n</i> 162)	18–64 years (<i>n</i> 1097)	18–64 years (<i>n</i> 889)	≥65 years (<i>n</i> 162)	18–64 years (<i>n</i> 1097)	18–64 years (<i>n</i> 889)	≥65 years (<i>n</i> 162)	18–64 years (<i>n</i> 1097)	18–64 years (<i>n</i> 889)	≥65 years (<i>n</i> 162)	18–64 years (<i>n</i> 1097)
Fresh meat	6.8	7.1	–	25.2	23.4	21.3	20.1	17.2	26.1	14.4	18.4	10.2
Meat products	1.4	1.3	–	2.7	2.3	3.8	0.0	0.0	6.2	5.1	4.0	7.3
Meat dishes	11.0	10.0	–	0.1	0.0	7.2	0.1	0.2	6.0	11.3	7.9	6.1
Fish, fish products and fish dishes	3.4	5.1	–	33.6	47.7	31.3	38.5	52.4	35.9	0.3	0.5	1.1
Egg and egg dishes	1.9	1.8	–	1.4	1.6	0.3	15.9	9.7	9.3	0.8	1.4	2.6
Spreading fats and oils	11.5	12.8	–	3.6	3.3	12.2	0.0	0.0	0.3	1.4	1.6	5.9
Butter	8.0	6.9	–	9.2	8.1	5.5	2.4	2.0	2.8	5.6	6.1	10.7
Potatoes chipped, fried and roasted	2.1	2.1	–	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	2.3
Potato products	8.1	5.8	–	1.9	1.5	0.1	6.4	5.9	0.1	0.5	0.6	0.7
Potatoes	0.0	0.0	–	4.0	2.2	0.2	0.0	0.0	0.0	1.1	0.9	2.1
Breads and rolls	0.8	1.1	–	0.0	0.0	0.3	0.0	0.0	0.7	1.1	1.0	4.0
Biscuits, cakes, pastries and buns	2.0	1.9	–	0.1	0.0	0.6	0.6	0.3	1.6	5.8	5.1	8.6
Sugars, confectionery and preserves	1.5	1.2	–	0.0	0.0	0.0	0.0	0.0	0.0	5.1	5.0	1.7
Puddings and chilled desserts	1.5	2.1	–	1.6	1.1	1.3	1.5	1.7	1.2	5.7	7.1	3.6
Ice cream and cream	0.6	0.5	–	1.4	0.2	0.7	0.1	0.0	0.4	2.6	2.7	2.3
Cheeses	1.0	0.8	–	8.7	5.4	4.4	11.0	8.8	2.7	16.9	17.2	10.8
Whole milk	5.2	5.2	–	1.9	1.2	6.8	0.3	0.1	3.8	11.1	8.6	6.6
Low-fat, skimmed and fortified milk	1.0	0.7	–	0.0	0.0	1.8	0.1	0.0	0.6	5.4	6.2	3.8
Savouries (e.g. pizza, quiche)	2.7	3.4	–	1.2	0.5	0.6	0.9	0.5	1.4	2.6	2.3	2.0
Savoury snacks (e.g. crisps)	2.0	1.9	–	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.5
Vegetable and pulse dishes	4.9	6.1	–	0.7	1.1	0.5	0.3	0.6	0.6	0.6	0.9	1.3
Nuts and seeds, herbs and spices	2.6	0.7	–	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Soups, sauces and miscellaneous foods	9.0	8.6	–	1.4	0.3	0.4	0.7	0.5	0.3	0.8	1.1	4.6
RTEBC	1.5	2.0	–	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Others*	8.9	10.4	–	0.6	0.1	0.3	0.4	0.1	0.3	1.0	0.6	0.7
Nutritional supplements†	0.7	0.6	–	5.7	10.6	4.2	4.0	6.6	3.6	–	–	–

n, Number of participants; RTEBC, ready-to-eat breakfast cereals.

* Other food groups include rice, pasta, flours, grains, other breakfast cereals, non-alcoholic beverages, nuts and seeds, herbs and spices, fruit, vegetables, other milk and milk-based beverages.

† Dietary intakes from food and food supplements were included in the analysis of the contribution of food supplements to total population ALA, EPA and DHA intakes.

is similar to the UK⁽²¹⁾ and other EU countries⁽⁴²⁾. However, only 52.6% of Irish consumers (data not shown) eat fish in any form, and in 2011 intake of fish, fish products and dishes was higher in older than in younger adults (data not shown) and in supplement users than in non-users. These patterns were not observed in 2001. This suggests that there is a segment of the Irish population who do not consume fish or fish oil supplements and with inadequate intakes of beneficial long-chain *n*-3 fatty acids.

In 2011, average population intakes of total fat (34.1%TE) were within EFSA recommendations⁽⁸⁾ of <35%TE based on the practical considerations and evidence from intervention studies, with intakes higher than reported most recently for Finland or the UK^(20,21). In 2011, the major contributing food groups to total fat intake were dairy products, fresh meat, meat products and biscuits, cakes, pastries and buns, which is similar to 2001 Irish data and to other EU countries⁽⁴²⁾ and the USA⁽¹¹⁾. Average intakes of PUFA by Irish adults in 2011 met the UK's recommendation at $\geq 6\%$ TE⁽⁹⁾, albeit intakes were slightly lower in men of all ages (approximately 5.7%). Intakes of PUFA by Irish 18–64-year-olds have declined slightly (1%) since 2001, as has been reported elsewhere^(21,48). Coupled with the observed reduction in SFA intakes, this suggests that reductions in SFA intakes do not automatically result in an increase in PUFA intakes, as observed elsewhere⁽⁴⁴⁾. Of note, replacement of SFA with PUFA, rather than MUFA or carbohydrates, is deemed to prevent CHD and to reduce CHD incidence over a wide range of intakes^(49,50). Hence, any future initiatives to reduce SFA intakes should consider strategies for its replacement.

The strength of this study relates to the quality of the data collected in two national food consumption surveys using estimated and semi-weighed food records, with statistical account given to the differing durations of data recording periods. Particular attention was given to obtaining the most up-to-date fatty acid composition data for foods by availing of updated food composition tables and, as available, analytical data provided by regulatory bodies and the food industry in Ireland. Nevertheless, these data were not available for all foods, and data were not included for the *n*-6 PUFA; these limitations must be acknowledged. Future studies should estimate intakes of *n*-6 PUFA to complement the dietary intake data. Other limitations include the self-reported nature of the food diaries, the observational study design and the exclusion of 20–30% of the original study populations because of their classification as under-reporters. Nevertheless, levels of under-reporting were similar to that reported elsewhere⁽²¹⁾, and their exclusion of under-reporters deemed important to avoid reporting trends based on increasing levels of under-reporting rather than true changes in fat intake, as reported elsewhere⁽⁵¹⁾. Levels of under-reporting had increased from 20% in 2001 to 30% in 2011, with the profile of under-reporters more likely to be male and slightly older in 2011 than in 2001 (48% male in 2011 *v.* 38% in 2001; mean age 45 (SD 16) *v.* 42 (SD 12) years). Other limitations relate to intakes of less frequently consumed fatty acid such as EPA and DHA, which may have been underestimated given the short study duration (4 d), where at least 15 d of dietary recording for men and 30 d for women are recommended to account for variations in PUFA intakes^(52,53). Hence, a true distribution of usual intakes typically requires

intake estimates over many days or the use of statistical modelling. Usual intakes were not assessed in this paper; however, by assessing intakes over 4 survey days, this will partly offset any overestimation in the proportion of people above and below the extremes of intake. Nevertheless, this paper provides a comprehensive estimate of dietary fat and fatty acid intakes in Irish adults using up-to-date composition information, which can be used to inform food-based dietary guidelines and public health policy.

In conclusion, improvements in dietary fat intakes in Irish adults were observed with significant improvements in the direction of dietary recommendations during the last decade; however, the possibility remains for improvement in intakes of SFA and PUFA. Future strategies to modulate population dietary fat intakes should consider not only the quantity and quality of fat consumed across the life span, but also the nature of the contributing foods involved and whether replacement strategies are needed when suggesting reductions in intakes of any one fat type.

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There are no conflicts of interest to declare.

Supplementary material

For supplementary material/s referred to in this article, please visit <http://dx.doi.org/doi:10.1017/S0007114516000787>

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