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Consumption of added fats and oils in the European Prospective Investigation into Cancer and Nutrition (EPIC) centres across 10 European countries as assessed by 24-hour dietary recalls

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Abstract

Objective: To evaluate the consumption of added fats and oils across the European centres and countries participating in the European Prospective Investigation into Cancer and Nutrition (EPIC).

Design and setting: 24-Hour dietary recalls were collected by means of standardised computer-guided interviews in 27 redefined EPIC centres across 10 European countries.

Subjects: From an initial number of 36 900 subjects, single dietary recalls from 22 924 women and 13 031 men in the age range of 35–74 years were included.

Results: Mean daily intake of added fats and oils varied between 16.2 g (Varese, Italy) and 41.1 g (Malmö, Sweden) in women and between 24.7 g (Ragusa, Italy) and 66.0 g (Potsdam, Germany) in men. Total mean lipid intake by consumption of added fats and oils, including those used for sauce preparation, ranged between 18.3 (Norway) and 37.2 g day^{-1} (Greece) in women and 28.4 (Heidelberg, Germany) and 51.2 g day^{-1} (Greece) in men. The Mediterranean EPIC centres with high olive oil consumption combined with low animal fat intake contrasted with the central and northern European centres where fewer vegetable oils, more animal fats and a high proportion of margarine were consumed. The consumption of added fats and oils of animal origin was highest in the German EPIC centres, followed by the French. The contribution of added fats and oils to total energy intake ranged from 8% in Norway to 22% in Greece.

Conclusions: The results demonstrate a high variation in dietary intake of added fats and oils in EPIC, providing a good opportunity to elucidate the role of dietary fats in cancer aetiology.

Keywords
EPIC study
Diet
Food intake
Fat
Oil
Lipids
24-Hour dietary recall
Europe

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There is evidence from both epidemiological and experimental studies that the types of fat consumed as well as the amounts may influence the development and subsequent progression of a number of chronic diseases, including obesity and obesity-related diseases, coronary heart disease and cancer[1,2]. Besides the question of a balanced energy intake and energy expenditure, it has been suggested that diets high in fat increase the risk of becoming overweight, although results from experimental and intervention studies do not support this[3–7]. However, high priority is given to the control of fat intake for obesity-related diseases such as non-insulin-dependent diabetes mellitus, hypertension and hyperlipoproteinaemia[8]. The association between level of dietary lipid intake and cardiovascular disease risk is well established. Owing to the availability of plasma lipoproteins as intermediate effect markers, the different effects of saturated, mono-unsaturated, $n-6$ polyunsaturated, $n-3$ polyunsaturated and *trans*-fatty acids have been described along with the underlying biological mechanisms[9,10]. However, the scientific evidence for a significant decrease in cardiovascular disease risk (morbidity and mortality) by lowering and modifying fat intake, and thus affecting plasma lipoproteins, is not straightforward[11,12]. Identification of the role of fat and fatty acids in carcinogenesis is even more difficult, mainly due to the absence of intermediate effect markers. Besides plausible biological explanations, the epidemiological evidence is not strong for most cancer sites[13–15].

Consumption of added fats and oils provides an important contribution to total lipid intake. At the food level, there may be further interesting compounds in addition to the fat content and the fatty acid pattern of fats and oils. Minor food components such as tocopherols, polyphenols in native olive oil and conjugated linoleic acid in ruminant fat (e.g. butter, dairy products) are also thought to have effects on health[10,16,17].

The supply of added fats and oils in Europe is diverse and has changed considerably over the last 50 years, in central and northern Europe as well as in the more southern areas[18–20]. This is due to changes in the agricultural and industrial production of fats and oils as well as to changes in consumer habits and attitudes, not least influenced by health claims in terms of reduction of blood cholesterol levels. In the British diet, for example, the consumption of ruminant fat (e.g. butter, dairy cream) has declined over the past century and that of vegetable oil and margarine has increased, leading to a much higher linoleic acid intake. Similar changes have taken place in The Netherlands and Sweden[18]. In contrast, olive oil is still the dominant dietary lipid source in the Mediterranean countries[19,21].

The European Prospective Investigation into Cancer and Nutrition (EPIC), as a European multi-centre study focusing on the effect of diet on cancer development, is able to give further insight into the role of dietary fat in cancer aetiology. However, this implies an extensive and precise knowledge of the individual exposure level of the participants. At present, a common international or European surveillance system providing comparable information on the dietary intake of added fats and oils at the individual level is not available. Comparable data on food availability at the household level are available through the DAFNE (DAta Food NEtworking) databank[22–24]. With the highly standardised 24-hour recall technique applied in all EPIC centres[25], a high-quality source of recent dietary intake data for comparison of differences between participating European centres is available. Making use of these data, the present paper aims to describe the intake of added fats and oils in EPIC centres across 10 European countries, also taking into account the contribution of fats and oils used as an ingredient for sauce preparation.

Subjects and methods

The EPIC cohort includes about half a million subjects from 10 European countries. Information on the usual diet of all participants has been assessed by country-specific instruments. In order to adjust (at the group level) for systematic measurement error between countries, highly standardised 24-hour recalls were performed on a subsample of the cohort as an additional dietary measurement[26]. The aim was to collect 24-hour recalls in a stratified random sample of 5–12% (1.5% in the UK) of all centre-specific cohorts considering the expected cancer incidence in gender- and age-specific strata[27]. This original sample included 36 900 subjects but was reduced to 35 955 participants after exclusion of subjects under 35 and over 74 years of age. The participants in this calibration study, therefore, should reflect the centre-specific EPIC cohorts, but not the general population in the centre area or country (with few exceptions, e.g. Norway). The present evaluation is based on single 24-hour recalls from 22 924 women and 13 031 men participating in the EPIC calibration study between 1995 and 1998 (except Norway: 1999–2000). The distribution of the study participants over the 27 redefined EPIC study centres is given in the tables; in France, Norway, Utrecht (The Netherlands) and Naples (Italy), only women were recruited. In France, Greece and Norway, study participants were recruited from all over the country; study regions were defined *a posteriori* in France and Norway. All participants included in the present analyses were in the age range of 35–74 years at recruitment. A detailed description of further characteristics of the study participants is given elsewhere in this supplement[27].

A computerised 24-hour dietary recall interview program, called EPIC-SOFT, was developed as a calibration instrument by the International Agency for Research on Cancer in co-operation with all EPIC study centres[25,28]. The program was adapted for each participating country in terms of foods and recipes included.

EPIC-SOFT provided a common structure and interview interface to achieve optimised standardisation of the dietary interview procedure within and between EPIC centres. On the basis of a predefined list of food groups and sub-groups, the countries listed the single food items expected to be consumed by their participants. The open design allowed a steady modification of the food item list. In EPIC-SOFT, the following quantification methods were available for estimating portion sizes: weight/volume, food photographs (e.g. amount of fat spread on bread), standard units, household measurements, standard portions. Preliminary and country-specific data on the energy, fat, carbohydrate and alcohol contents of the food items were inserted to allow a rapid quality check at the end of the interview[29]. These estimates were also used in the present study for calculations on the nutrient (energy, fat) level.

The present evaluation deals with the intake of the food group 'added fats and oils'. By means of EPIC-SOFT, information on fats and oils used for cooking was collected in a highly standardised way, measured separately from the food that included them. Figure 1 provides information on the definition of food sub-groups. Most sub-groups were contained entirely in EPIC-SOFT; others were newly established (sub-groups for vegetable oils, margarines) by reclassifying country-specific food items.

In EPIC-SOFT, sauces were included in separate sub-groups, i.e. 'tomato sauces', 'dressing sauces', 'dessert sauces' and 'unclassified/other sauces'. Because of its high fat content, the sub-group 'mayonnaises and similar' was not treated as a sauce (as indicated in EPIC-SOFT) but as an ordinary sub-group of fats and oils (Fig. 1). Besides information on the amount of sauces consumed, information on the type of fats and oils used for preparation of the sauces was gained systematically through the interview (facet in EPIC-SOFT). However, the quantity of the fats or oils was not solicited during the interview. The amount of lipid (nutrient) provided was computed based on standard country- or centre-specific recipes and is available for further evaluation. Therefore, the amount of fat/lipid intake by sauces and its contribution to the total intake of added fats and oils can only be considered when intake data were expressed in terms of grams of lipid per day. If several types of fats and oils were used for the preparation of one sauce, each type was said to have contributed equally. Then, the total lipid (nutrient) intake by consumption of added fats and oils, including fats and oils used as ingredients for sauce preparation, was calculated.

Crude intake values are given as the arithmetic mean, adjusted values as the mean and standard error of the mean. Adjustment within centres was performed to correct for deviations from an ideal sampling of the 24-hour recalls (day of the week, season) as well as for age. For days of the week, two discrete levels (Monday–Friday, Saturday–Sunday) and for season four discrete levels were chosen for weighting. Age was included as a continuous variable (regression model). Adjustment was done separately for women and men. In order to consider the differences in total energy intake between subjects, the percentage of total daily energy intake provided by lipids originating from the consumption of added fats and oils was calculated for each subject, followed by application of the same adjustment procedure as described above.

Factors significantly affecting the consumption of added fats and oils, as well as the intake of lipids originating from the consumption of fats and oils (including sauces), were identified by means of analysis of variance. For factors for which the results were not stratified, testing of statistical significance between groups was performed with the least

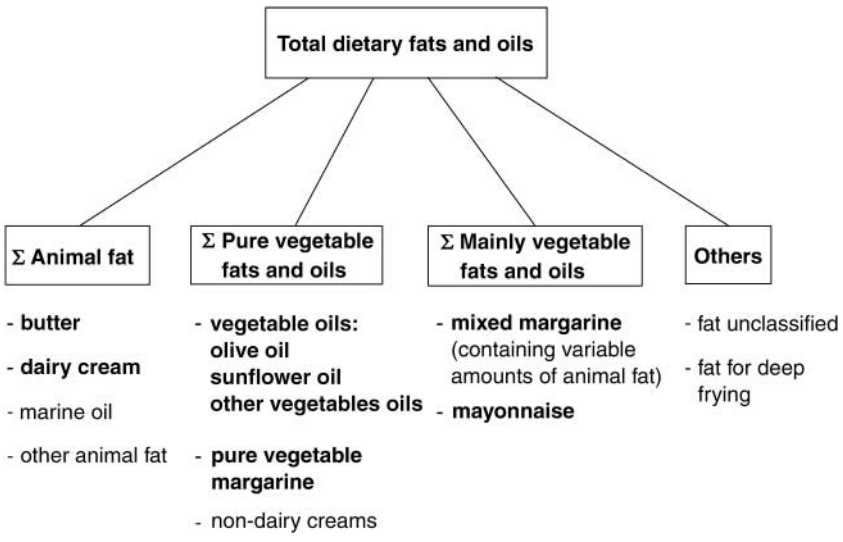

Fig. 1 Definition of sub-groups within the food group 'added fats and oils' (sub-groups in bold are given in Tables 1–4)

significant difference (LSD) test at an α level of 5%. The factors centre, day of the week and season of the recall assessment, sex, age, body mass index, smoking, education, physical activity at work and sports activity were tested. Information on the latter four variables was collected by means of questionnaires and interviews at recruitment. Calculation of adjusted values was performed using SAS System® for Windows™ (Release 8.00, SAS Institute Inc., Cary, NC, USA). All other calculations were made by means of SPSS® for Windows™ Release 10.0.7 (SPSS Inc., Chicago, IL, USA).

Results

The observed variation in mean consumption of added fats and oils between EPIC centres was quite high (Tables 1a and 1b). The range of mean total intake of added fats and oils was from 16.2 (Varese, Italy) to 41.1 g day^{-1} (Malmo, Sweden) in women and from 24.7 (Ragusa, Italy) to 66.0 g day^{-1} (Potsdam, Germany) in men (results adjusted for day of the week, season and age).

The intake of animal fat, mainly butter, was highest in the German EPIC centres, followed by centres in France and the Nordic countries. Dairy cream intake was most common in the EPIC centres of the Nordic countries Sweden, Denmark and Norway. In most Greek, Spanish and Italian centres, animal fat intake was below 3 g day^{-1}.

This contrasts with the situation found for vegetable oil intake. In the Mediterranean centres of Italy, Spain and Greece, high intake values for vegetable oils were found, with olive oil by far the largest source. The highest mean intake values were found for Spanish centres and for Greece (up to 32.3 g day^{-1} in women and 46.5 g day^{-1} in men). In most other EPIC centres/countries, mean vegetable oil intake was around or below 6 g day^{-1}. Sunflower oil was consumed in most EPIC centres, although at a low level. The mean intakes of other vegetable oils were fairly low (<1 g day^{-1}) and concentrated in certain countries (Table 2). For example, peanut oil was more often used in the EPIC centres in France and Italy, grape oil in Danish and safflower oil in German centres. Some vegetable oil (about 2 g day^{-1} or less; except for men in Spain) could not be attributed to a unique source because the study participants either indicated unspecified 'vegetable oil' or the given oil consisted of a mixture of different oils.

The total margarine intake was reclassified owing to the high intake of margarine in several countries (Sweden, Denmark, Norway, the UK and The Netherlands), where both pure vegetable margarine and mixed-fat margarine (margarine containing a certain amount of animal fat) were available on the market (Fig. 1). The highest intake of mixed-fat margarines was found in the Swedish and Danish EPIC centres with up to 30.6 g day^{-1} in men (Table 1). A fairly high amount of pure vegetable margarine was consumed in Potsdam (Germany), contrasting with Heidelberg (Germany). Mean daily mayonnaise intake was highest in the Danish cohorts, especially in Copenhagen, with 4.6 g in women and 9.3 g in men. In other EPIC centres/countries the mean consumption levels of mayonnaise were mostly below 3 g day^{-1}.

Evaluation of the consumption frequency of fat-reduced products revealed distinct differences between butter and margarine. In 3.8% of all reports of butter consumption, the use of fat-reduced butter was indicated with a range of 0% (Swedish centres; no fat-reduced butter on the Swedish market) to 3% (British and German centres), except for the French (6.5%) and Dutch (8.5%) EPIC participants. On the contrary, fat-reduced margarines comprised almost one-third of all margarine consumption (33.8%), covering a very high range of variation from as low as 2.7% (Danish centres) and 3.7% (British centres) up to about 30% (Dutch centres) and 40% (German, Swedish and Norwegian centres); for Spanish and Italian centres, the corresponding figure was about 14%. The evaluation on the basis of lipid intake takes care of the different lipid contents in full-fat and fat-reduced butter and margarine (see below).

Overall, in about half of all reports of sauce consumption, the type of fat used for sauce preparation was specified. Specification refers largely to self-prepared dishes but was not possible for most commercial products. The highest degree of specification was reached in the French (79%), Italian (74%), Greek (69%) and Spanish (48%) EPIC centres, mainly reporting the use of olive oil. The fat specification in the EPIC centres in The Netherlands, the UK and the Nordic countries referred mainly to the use of margarine for sauce preparation. The use of dairy creams as a sauce ingredient was specified relatively often for EPIC centres in Germany and the Nordic countries (data not shown).

Considering the mean daily intake of lipids from added fats and oils, the contribution of added fats and oils in sauces to lipid intake from all fats and oils varied considerably from 0.7% (men from Murcia, Spain) up to 33.6% (men from Ragusa, Italy) (Tables 3a and 3b). At a country level, the contribution of lipids from sauces was highest in the French EPIC participants (27.7%) followed by the Italians and Dutch. Sauces contributed mainly to the absolute intake of pure vegetable lipids, i.e. vegetable oils, reflecting the fact that specification of the type of fat used for sauce preparation was given mainly for salad dressings and tomato sauces (Mediterranean countries). It should be mentioned that the figures for total lipid intake by added fats and oils (Table 3) include all lipids from sauces, i.e. also all sauce items in which the fat content was not specified.

The amounts of lipid given in Table 3 are different from the amounts of food given in Table 1. This is a reflection of the lower water content of oils compared with margarines and butter. EPIC centres with a high intake of margarine,

Table 1a Daily intake of added fats and oils (g day^{-1}, crude and adjusted*) in women from 27 centres across 10 European countries participating in the European Prospective Investigation into Cancer and Nutrition (EPIC) calibration study (24-hour recall)

		Total fats & oils			Animal fats & oils									Pure vegetable fats & oils															Mainly vegetable fats & oils					
					Total			Butter			Dairy cream			Total			Vegetable oils			Olive oil			Sunflower oil			Vegetable margarine			Mixed-fat margarine			Mayonnaise		
			Adjusted*			Adjusted*			Adjusted*			Adjusted*			Adjusted*			Adjusted*			Adjusted*			Adjusted*			Adjusted*			Adjusted*		
Country and centre	*n*	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM
Greece																																			
Greece	1374	36.0	35.7	0.8	0.8	0.9	0.5	0.3	0.5	0.3	0.3	0.2	0.4	34.2	33.6	0.5	32.2	31.6	0.3	29.9	29.4	0.3	1.7	1.6	0.1	2.0	2.0	0.3	–†	–	–	0.4	0.6	0.2
Spain																																			
Granada	300	31.2	31.7	1.6	1.2	1.4	1.1	0.8	1.1	0.6	0.3	0.3	0.9	28.6	28.9	1.0	24.9	25.0	0.7	22.1	22.5	0.6	1.1	0.9	0.3	3.7	3.9	0.7	–	–	–	1.4	1.3	0.4
Murcia	304	37.0	36.7	1.6	2.2	2.2	1.1	0.7	0.8	0.6	0.5	0.5	0.9	33.3	33.3	1.0	31.3	31.3	0.7	24.9	24.8	0.6	2.5	2.4	0.3	2.0	2.0	0.7	–	–	–	1.4	1.2	0.4
Navarra	271	36.3	36.2	1.7	1.3	1.2	1.2	0.7	0.6	0.7	0.6	0.6	0.9	33.7	33.9	1.0	32.1	32.3	0.7	26.9	26.9	0.6	2.1	2.2	0.3	1.6	1.6	0.7	–	–	–	1.2	1.1	0.4
San Sebastian	244	35.8	35.1	1.8	1.1	1.3	1.3	0.4	0.4	0.7	0.7	0.9	1.0	32.6	32.2	1.1	30.2	29.8	0.8	21.6	21.1	0.7	6.5	6.7	0.3	2.4	2.3	0.8	–	–	–	2.0	1.7	0.4
Asturias	324	22.3	22.3	1.5	1.9	2.1	1.1	0.8	0.8	0.6	1.0	1.1	0.9	19.4	19.5	0.9	17.0	17.0	0.7	12.4	12.6	0.6	3.6	3.5	0.3	2.5	2.5	0.7	–	–	–	0.9	0.9	0.4
Italy																																			
Ragusa	138	21.7	21.9	2.4	1.5	1.2	1.7	0.4	0.3	0.9	1.0	0.8	1.3	20.1	20.8	0.5	19.8	20.5	1.0	16.7	17.5	0.9	0.6	0.6	0.4	0.3	0.3	1.0	–	–	–	0.0	0.1	0.6
Naples	403	20.5	20.3	1.4	1.8	1.7	1.0	0.8	0.8	0.5	0.7	0.8	0.8	18.4	18.3	0.8	18.1	18.1	0.6	13.7	13.7	0.5	1.4	1.5	0.2	0.2	0.2	0.6	–	–	–	0.2	0.2	0.3
Florence	785	23.9	24.1	1.0	2.7	2.7	0.7	2.1	2.1	0.4	0.6	0.6	0.6	20.3	20.5	0.6	20.1	20.4	0.4	18.8	19.2	0.4	0.1	0.1	0.2	0.1	0.1	0.4	–	–	–	0.5	0.5	0.3
Turin	392	24.1	23.8	1.4	2.5	2.4	1.0	1.5	1.5	0.6	0.9	0.8	0.8	19.6	19.4	0.9	19.2	19.1	0.6	15.9	15.9	0.5	0.7	0.6	0.2	0.3	0.3	0.6	–	–	–	1.8	1.7	0.4
Varese	794	16.2	16.2	1.0	3.3	3.6	0.7	2.6	2.8	0.4	0.6	0.7	0.5	11.9	11.7	0.6	11.8	11.5	0.4	10.0	9.9	0.4	0.1	0.1	0.2	0.2	0.2	0.4	–	–	–	0.6	0.6	0.2
France																																			
South coast	612	24.5	26.4	1.1	11.9	12.4	0.8	7.0	7.6	0.4	3.6	3.4	0.6	9.7	11.3	0.7	7.9	9.2	0.5	3.3	3.5	0.4	2.1	2.7	0.2	1.8	2.0	0.5	1.1	0.9	0.4	1.3	1.3	0.3
South	1396	23.7	23.7	0.7	14.0	14.0	0.5	8.6	8.6	0.3	3.9	4.0	0.4	7.8	7.8	0.5	5.9	6.0	0.3	2.4	2.3	0.3	1.5	1.5	0.1	1.9	1.9	0.3	0.2	0.2	0.3	1.0	1.1	0.2
North-west	622	24.9	25.4	1.0	16.3	16.0	0.8	12.0	12.0	0.4	3.7	3.4	0.6	5.5	6.3	0.7	2.9	3.4	0.5	1.3	1.7	0.4	0.5	0.6	0.2	2.5	2.9	0.5	1.1	1.1	0.4	1.4	1.4	0.3
North-east	2009	25.9	26.1	0.6	14.7	14.8	0.4	10.0	10.0	0.2	3.4	3.5	0.3	8.0	8.1	0.4	5.0	5.1	0.3	2.2	2.3	0.2	1.0	1.0	0.1	3.0	3.0	0.2	0.7	0.7	0.2	1.5	1.6	0.2
Germany																																			
Heidelberg	1087	27.6	28.1	0.9	18.5	19.3	0.6	13.1	13.6	0.3	5.3	5.5	0.5	7.4	7.5	0.5	3.1	3.1	0.4	1.0	0.9	0.3	0.9	1.0	0.1	4.4	4.4	0.4	–	–	–	0.3	0.2	0.2
Potsdam	1063	39.1	38.5	0.9	16.9	16.0	0.6	12.9	12.3	0.3	3.6	3.2	0.5	20.3	20.7	0.5	2.3	2.4	0.4	0.6	0.6	0.3	0.7	0.7	0.1	18.0	18.3	0.4	–	–	–	1.0	1.0	0.2
The Netherlands																																			
Bilthoven	1086	33.0	32.7	0.9	8.0	8.2	0.6	4.6	4.7	0.3	3.3	3.4	0.5	16.3	16.3	0.5	2.1	2.0	0.4	0.7	0.6	0.3	0.7	0.8	0.1	14.2	14.2	0.4	3.6	3.6	0.3	3.2	2.9	0.2
Utrecht	1874	29.4	29.0	0.6	8.2	8.2	0.5	4.7	4.8	0.3	3.5	3.4	0.4	15.8	15.3	0.4	1.5	1.5	0.3	0.5	0.5	0.2	0.4	0.4	0.1	14.2	13.8	0.3	2.5	2.5	0.2	1.7	1.8	0.2
United Kingdom																																			
General population	571	26.8	26.0	1.2	8.1	8.0	0.8	5.1	5.2	0.5	2.7	2.6	0.6	9.6	9.1	0.7	3.2	3.1	0.5	1.0	0.9	0.4	0.7	0.7	0.2	6.1	5.8	0.5	4.7	4.5	0.4	3.2	3.1	0.3
'Health-conscious'	197	28.7	29.6	2.0	7.5	7.3	1.4	5.7	5.6	0.8	1.7	1.7	1.1	15.4	17.1	0.2	5.9	6.3	0.8	3.0	3.3	0.7	1.3	1.2	0.3	9.5	10.8	0.9	3.2	2.8	0.7	2.2	2.1	0.5
Denmark																																			
Copenhagen	1485	32.7	33.8	0.7	13.8	14.2	0.5	3.9	3.8	0.3	9.7	0.1	0.4	4.2	4.2	0.4	1.9	1.9	0.3	1.0	1.0	0.3	0.2	0.2	0.1	2.2	2.3	0.3	9.5	9.9	0.3	4.4	4.6	0.2
Aarhus	510	30.2	30.9	1.2	11.2	11.0	0.9	3.3	3.2	0.5	7.7	7.7	0.7	4.0	4.1	0.8	1.7	1.7	0.5	0.9	0.8	0.5	0.1	0.1	0.2	2.3	2.4	0.5	10.1	10.8	0.4	3.8	3.9	0.3
Sweden																																			
Malmö	1711	41.4	41.1	0.7	10.9	10.6	0.5	1.6	1.5	0.3	9.2	9.0	0.4	12.0	11.9	0.4	1.0	1.0	0.3	0.3	0.4	0.3	0.2	0.1	0.1	9.4	9.3	0.3	15.1	15.0	0.2	2.6	2.7	0.2
Umeå	1574	37.7	37.7	0.7	9.7	9.8	0.5	1.4	1.4	0.3	8.3	8.3	0.4	9.3	9.2	0.4	1.6	1.5	0.3	0.4	0.4	0.3	0.0	0.0	0.1	7.5	7.5	0.3	16.2	16.2	0.3	1.8	1.8	0.2
Norway																																			
South & East	1136	28.5	28.8	0.8	10.6	11.2	0.6	3.3	3.4	0.3	7.2	7.8	0.5	11.5	11.3	0.5	1.8	1.7	0.4	1.5	1.5	0.3	0.0	0.1	0.1	9.7	9.6	0.4	3.6	3.6	0.3	2.2	2.0	0.2
North & West	662	29.2	29.9	1.1	10.4	10.6	0.8	2.5	2.5	0.4	7.8	8.0	0.6	11.2	11.7	0.7	1.1	1.1	0.5	0.7	0.7	0.4	0.0	0.0	0.2	10.0	10.6	0.5	4.2	4.4	0.4	2.9	2.6	0.3

SEM – standard error of the mean.
* Adjusted for age as well as for day of the week and season of the 24-hour recall assessment.
† Mixed-fat margarine not available on the market or not consumed.

Table 1b Daily intake of added fats and oils (g day^{-1}, crude and adjusted*) in men from 19 centres across 10 European countries participating in the European Prospective Investigation into Cancer and Nutrition (EPIC) calibration study (24-hour recall)

		Total fats & oils			Animal fats & oils									Pure vegetable fats & oils															Mainly vegetable fats & oils					
					Total			Butter			Dairy cream			Total			Vegetable oils			Olive oil			Sunflower oil			Vegetable margarine			Mixed-fat margarine			Mayonnaise		
			Adjusted*			Adjusted*			Adjusted*			Adjusted*			Adjusted*			Adjusted*			Adjusted*			Adjusted*			Adjusted*			Adjusted*		
Country and centre	*n*	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM	Crude mean	Mean	SEM
Greece																																			
Greece	1312	48.5	49.1	1.1	0.7	0.6	0.7	0.4	0.2	0.5	0.1	0.0	0.5	46.0	46.0	0.7	43.8	43.9	0.4	40.2	40.6	0.4	2.7	2.4	0.2	2.2	2.0	0.6	–†	–	–	0.4	0.6	0.3
Spain																																			
Granada	214	45.4	46.6	2.6	2.5	2.3	1.7	1.8	1.7	1.1	0.7	0.6	1.2	40.1	41.6	1.8	37.6	38.7	1.1	34.3	35.3	1.0	0.6	0.5	0.4	2.5	2.9	1.4	–	–	–	2.8	2.6	0.7
Murcia	243	43.5	43.0	2.4	1.8	1.9	1.6	1.1	1.3	1.1	0.2	0.2	1.1	39.5	39.2	1.7	37.9	37.8	1.0	30.8	30.9	1.0	1.4	1.4	0.4	1.6	1.4	1.3	–	–	–	2.2	2.0	0.7
Navarra	444	49.4	49.4	1.8	0.3	0.3	1.2	0.2	0.2	0.8	0.1	0.1	0.8	47.3	47.3	1.2	46.5	46.5	0.7	36.0	36.2	0.7	3.9	3.8	0.3	0.8	0.8	1.0	–	–	–	1.8	1.7	0.5
San Sebastian	490	45.8	44.9	1.7	0.8	1.2	1.1	0.2	0.4	0.8	0.6	0.8	0.8	42.8	42.4	1.2	41.4	41.5	0.7	23.4	23.6	0.7	8.9	8.9	0.3	1.4	0.9	0.9	–	–	–	2.2	1.7	0.5
Asturias	386	33.0	33.1	1.9	1.1	1.2	1.3	0.3	0.3	0.8	0.7	0.7	0.9	30.5	30.6	1.3	27.9	28.2	0.8	20.9	21.2	0.8	3.5	3.5	0.3	2.6	2.4	1.0	–	–	–	1.3	1.3	0.5
Italy																																			
Ragusa	168	27.7	24.7	3.0	1.2	1.2	1.9	0.6	0.6	1.3	0.4	0.4	1.3	25.6	22.8	2.0	25.3	22.5	1.2	22.0	19.1	1.2	0.0	0.0	0.5	0.2	0.0	1.6	–	–	–	0.1	0.1	0.8
Florence	271	33.6	34.5	2.3	3.7	3.8	1.5	2.9	3.0	1.0	0.7	0.7	1.0	28.4	28.9	1.6	28.2	28.8	1.0	26.5	27.0	0.9	0.1	0.1	0.4	0.2	0.0	1.3	–	–	–	0.9	1.3	0.7
Turin	677	30.8	30.5	1.5	2.7	3.0	0.9	1.6	1.7	0.6	0.9	1.0	0.6	24.8	24.3	1.0	24.5	24.1	0.6	21.1	20.9	0.6	0.6	0.6	0.2	0.3	0.2	0.8	–	–	–	2.5	2.5	0.4
Varese	328	22.4	24.9	2.1	4.4	4.6	1.4	3.7	3.5	0.9	0.5	0.7	0.9	16.3	18.6	1.4	15.9	18.0	0.9	13.6	15.6	0.8	0.1	0.1	0.3	0.3	0.6	1.1	–	–	–	0.5	0.5	0.6
Germany																																			
Heidelberg	1033	35.2	36.3	1.2	21.3	22.8	0.8	16.7	7.6	0.5	4.5	5.1	0.5	10.7	10.6	0.8	3.3	3.4	0.5	0.8	0.9	0.5	0.7	0.7	0.2	7.4	7.2	0.6	–	–	–	0.5	0.4	0.3
Potsdam	1235	66.0	66.0	1.1	26.1	26.5	0.7	21.6	1.8	0.5	3.2	3.3	0.5	37.1	36.8	0.7	2.3	2.2	0.4	0.2	0.2	0.4	0.9	0.8	0.2	34.8	34.5	0.6	–	–	–	1.5	1.5	0.3
The Netherlands																																			
Bilthoven	1024	50.9	50.6	1.3	8.7	9.2	0.8	4.9	5.1	0.5	3.7	4.0	0.5	29.5	29.3	0.9	2.6	2.5	0.5	0.5	0.6	0.5	0.7	0.6	0.2	26.9	26.9	0.7	5.5	5.5	0.6	4.0	3.6	0.3
United Kingdom																																			
General population	404	43.7	44.2	1.9	12.2	11.9	1.2	8.3	8.1	0.8	3.6	3.6	0.8	17.7	17.9	1.3	4.4	4.6	0.8	0.9	0.9	0.8	1.1	1.0	0.3	12.8	12.9	1.0	8.5	8.7	1.0	2.9	3.1	0.5
'Health-conscious'	114	40.4	38.8	3.6	8.1	9.1	2.3	6.4	7.7	1.5	1.7	1.3	1.6	26.8	24.6	2.4	8.0	6.9	1.5	3.0	2.7	1.4	2.3	1.7	0.6	18.8	17.7	0.9	2.5	2.1	1.8	2.6	2.8	1.0
Denmark																																			
Copenhagen	1356	49.2	49.8	1.0	14.6	14.7	0.7	6.5	6.4	0.4	7.3	7.5	0.5	7.1	7.1	0.7	2.2	2.3	0.4	1.1	1.1	0.4	0.2	0.2	0.2	4.9	4.8	0.6	16.6	17.0	0.5	9.2	9.3	0.3
Aarhus	567	53.2	52.1	1.6	15.9	15.0	1.0	5.7	5.4	0.7	9.8	9.1	0.7	7.9	7.9	1.1	1.7	1.6	0.7	0.7	0.7	0.6	0.2	0.1	0.3	6.2	6.3	0.9	22.1	21.6	0.8	5.8	6.2	0.5
Sweden																																			
Malmö	1421	59.5	60.6	1.1	10.0	9.7	0.7	2.4	2.1	0.5	7.5	7.5	0.5	17.8	18.3	0.7	1.2	1.4	0.4	0.3	0.3	0.4	0.2	0.3	0.2	15.2	15.7	0.6	26.8	27.1	0.5	3.3	3.4	0.3
Umeå	1344	62.4	63.1	1.0	12.8	13.0	0.7	3.5	4.0	0.5	9.3	9.0	0.5	15.7	15.6	0.7	1.2	1.2	0.4	0.3	0.3	0.4	0.0	0.0	0.2	14.3	14.3	0.6	30.2	30.6	0.5	2.0	2.0	0.3

SEM – standard error of the mean.
* Adjusted for age as well as for day of the week and season of the 24-hour recall assessment.
† Mixed-fat margarine not available on the market or not consumed.

Table 2 Daily intake of vegetable oils other than olive and sunflower (g day^{-1}, adjusted*) in women and men participating in the European Prospective Investigation into Cancer and Nutrition (EPIC) calibration study (24-hour recall) across 10 European countries

			Vegetable oil							
Country	*n*		Corn	Peanut	Grape	Rapeseed	Safflower	Soy	Walnut	Others†
WOMEN										
Greece	1374	Mean	0.47	0.00	0.00	0.00	0.00	0.03	0.00	0.10
		SEM	0.05	0.00	0.00	0.00	0.02	0.03	0.01	0.13
Spain	1443	Mean	0.07	0.00	0.00	0.00	0.00	0.16	0.00	2.11
		SEM	0.05	0.05	0.04	0.02	0.00	0.02	0.00	0.12
Italy	2512	Mean	0.64	0.50	0.01	0.00	0.00	0.13	0.00	0.55
		SEM	0.04	0.04	0.03	0.01	0.00	0.02	0.00	0.09
France	4639	Mean	0.05	0.53	0.16	0.01	0.01	0.00	0.02	1.23
		SEM	0.03	0.03	0.02	0.01	0.01	0.00	0.00	0.07
Germany	2150	Mean	0.19	0.00	0.00	0.00	0.24	0.00	0.01	0.70
		SEM	0.04	0.05	0.03	0.02	0.01	0.02	0.01	0.10
The Netherlands	2960	Mean	0.06	0.03	0.00	0.00	0.01	0.02	0.00	0.48
		SEM	0.04	0.04	0.03	0.01	0.01	0.02	0.01	0.09
United Kingdom	768	Mean	0.21	0.03	0.02	0.09	0.00	0.03	0.01	1.15
		SEM	0.07	0.07	0.05	0.03	0.02	0.03	0.01	0.17
Denmark	1995	Mean	0.05	0.00	0.34	0.01	0.04	0.00	0.00	0.28
		SEM	0.04	0.04	0.03	0.02	0.01	0.02	0.01	0.10
Sweden	3285	Mean	0.17	0.00	0.00	0.16	0.00	0.00	0.00	0.49
		SEM	0.03	0.00	0.02	0.01	0.01	0.00	0.01	0.08
Norway	1798	Mean	0.06	0.03	0.00	0.01	0.00	0.17	0.00	0.00
		SEM	0.05	0.05	0.03	0.02	0.00	0.02	0.01	0.11
MEN										
Greece	1312	Mean	0.47	0.00	0.00	0.00	0.00	0.20	0.00	0.23
		SEM	0.07	0.03	0.03	0.00	0.00	0.04	0.00	0.18
Spain	1777	Mean	0.12	0.00	0.00	0.00	0.00	0.09	0.00	5.73
		SEM	0.06	0.00	0.00	0.02	0.02	0.04	0.00	0.15
Italy	1444	Mean	0.68	0.27	0.00	0.00	0.00	0.18	0.00	1.29
		SEM	0.07	0.02	0.00	0.02	0.03	0.04	0.01	0.17
Germany	2268	Mean	0.14	0.01	0.00	0.00	0.29	0.02	0.02	0.97
		SEM	0.05	0.02	0.02	0.01	0.02	0.03	0.00	0.13
The Netherlands	1024	Mean	0.08	0.04	0.00	0.00	0.02	0.05	0.00	1.04
		SEM	0.08	0.03	0.00	0.02	0.03	0.05	0.01	0.21
United Kingdom	518	Mean	0.11	0.08	0.00	0.07	0.02	0.01	0.00	2.28
		SEM	0.11	0.04	0.05	0.03	0.04	0.07	0.00	0.28
Denmark	1923	Mean	0.11	0.01	0.38	0.02	0.00	0.00	0.00	0.40
		SEM	0.06	0.02	0.03	0.02	0.02	0.03	0.00	0.14
Sweden	2765	Mean	0.15	0.00	0.01	0.11	0.00	0.00	0.00	0.67
		SEM	0.05	0.02	0.02	0.01	0.00	0.00	0.00	0.12

SEM – standard error of the mean.
* Adjusted for age as well as for day of the week and season of the 24-hour recall assessment.
† Mixtures of different oils, unspecified oils.

fat-reduced margarine or dairy cream were no longer at the top range of intake but changed positions with centres with a high vegetable oil intake, i.e. the Mediterranean centres in Greece and Spain. Looking at the ratio of lipids from animal fat to that from vegetable fat and oils, the situation did not change substantially; the highest ratio was still found for the German EPIC centres, particularly for Heidelberg.

The contribution of lipid intake (by consumption of added fats and oils including sauces) to the total daily energy intake is shown in Tables 4a and 4b. The highest mean contribution was obtained in Greece with about 22% of energy followed by the Spanish centres (about 15% of energy on average). In most other EPIC centres/countries, women reported values of about 11 ± 1% of energy (except Norway) and men of about 12 ± 1% of energy. Expressed as percentage of total daily lipid (nutrient) intake, the differences in consumption of added fats and oils across EPIC centres and countries are not distinctly different from the results given in percentage of energy (Table 4). However, the Italian EPIC participants became quite similar to the Spanish ones, indicating a low contribution of total lipid intake to total energy intake in the Italian cohorts.

Total energy intake was strongly correlated with the consumption of added fats and oils. Moreover, the factors centre, smoking (three groups), education (five levels), gender, age (four groups) and season significantly ($P < 0.001$; factors in decreasing order of importance) affected fat and oil consumption, as well as lipid intake by consumption of added fats and oils including sauces. Smokers had a higher intake of fats and oils than former or never smokers (Table 5). With increasing education level, the intake values decreased. Without energy adjustment,

Table 3a Daily intake of lipids (g lipid day^{-1}, adjusted*) by consumption of added fats and oils, including fats and oils used for sauce preparation and indicating the percentage contribution of sauces to the combined lipid intake, in women from 27 centres across 10 European countries participating in the European Prospective Investigation into Cancer and Nutrition (EPIC) calibration study (24-hour recall)

		Total fats & oils			Animal fats & oils								Pure vegetable fats & oils										Mainly vegetable fats & oils							
					Total			Butter		Dairy cream			Total			Vegetable oils			Olive oil		Vegetable margarine			Total			Mixed-fat margarine		Mayonnaise	
		g lipid day^{-1}			g lipid day^{-1}			g lipid day^{-1}		g lipid day^{-1}			g lipid day^{-1}			g lipid day^{-1}			g lipid day^{-1}		g lipid day^{-1}			g lipid day^{-1}			g lipid day^{-1}		g lipid day^{-1}	
Country and centre	*n*	Mean	SEM	*% from sauces*	Mean	SEM	*% from sauces*	Mean	SEM	Mean	SEM		Mean	SEM	*% from sauces*	Mean	SEM	*% from sauces*	Mean	SEM	Mean	SEM		Mean	SEM	*% from sauces*	Mean	SEM	Mean	SEM
Greece																														
Greece	1374	37.2	0.5	*5.4*	0.7	0.3	*6.6*	0.4	0.2	0.1	0.1		35.3	0.4	*5.4*	33.3	0.4	*4.7*	31.1	0.3	2.0	0.2		0.5	0.2	*0.0*	–†	–	0.5	0.1
Spain																														
Granada	300	30.7	1.2	*2.0*	1.0	0.6	*0.0*	0.9	0.5	0.1	0.3		28.7	0.9	*2.1*	25.6	0.8	*3.5*	23.0	0.6	3.1	0.5		0.9	0.5	*0.2*	–	–	1.0	0.3
Murcia	304	36.7	1.2	*0.8*	1.7	0.6	*0.0*	0.6	0.5	0.2	0.3		33.1	0.9	*0.9*	31.6	0.7	*2.6*	25.1	0.6	1.4	0.5		0.9	0.5	*0.7*	–	–	0.9	0.3
Navarra	271	35.9	1.2	*1.9*	0.7	0.7	*0.0*	0.5	0.6	0.2	0.3		34.4	0.9	*2.0*	33.0	0.8	*2.4*	27.5	0.7	1.3	0.5		0.9	0.5	*0.4*	–	–	0.9	0.3
San Sebastian	244	35.5	1.3	*4.5*	0.6	0.7	*5.9*	0.4	0.6	0.3	0.3		33.6	1.0	*4.5*	31.6	0.8	*5.8*	22.3	0.7	2.0	0.6		1.3	0.6	*0.5*	–	–	1.3	0.3
Asturias	324	22.2	1.1	*6.8*	1.2	0.6	*1.5*	0.7	0.5	0.4	0.3		20.5	0.9	*7.3*	18.5	0.7	*8.5*	13.9	0.6	2.0	0.5		0.6	0.5	*0.7*	–	–	0.6	0.3
Italy																														
Ragusa	138	27.5	1.7	*22.8*	0.7	0.9	*13.8*	0.4	0.8	0.3	0.4		27.0	1.3	*22.9*	26.7	1.1	*23.0*	23.0	0.9	0.3	0.7		0.0	0.8	*0.0*	–	–	0.0	0.4
Naples	403	24.1	1.0	*19.0*	1.1	0.6	*5.7*	0.7	0.5	0.3	0.3		22.8	0.8	*19.8*	22.6	0.6	*19.9*	18.2	0.6	0.2	0.4		0.1	0.4	*1.6*	–	–	0.1	0.2
Florence	785	24.9	0.7	*7.6*	2.1	0.4	*7.3*	1.8	0.3	0.2	0.2		22.3	0.6	*8.1*	22.2	0.5	*8.3*	20.9	0.4	0.1	0.3		0.3	0.3	*0.0*	–	–	0.3	0.2
Turin	392	23.7	1.0	*6.7*	1.8	0.6	*9.4*	1.3	0.5	0.3	0.3		20.9	0.8	*6.7*	20.6	0.7	*8.5*	17.2	0.6	0.3	0.4		0.8	0.5	*0.2*	–	–	0.8	0.3
Varese	794	21.6	0.7	*31.4*	3.1	0.4	*14.8*	2.8	0.3	0.2	0.2		18.0	0.6	*35.1*	17.8	0.5	*35.7*	15.6	0.4	0.2	0.3		0.3	0.3	*0.1*	–	–	0.3	0.2
France																														
South coast	612	29.2	0.8	*26.7*	9.0	0.4	*5.6*	6.5	0.4	1.1	0.2		18.1	0.6	*40.2*	16.5	0.5	*45.1*	8.0	0.4	1.6	0.4		1.6	0.4	*0.0*	0.6	0.3	0.9	0.2
South	1396	27.3	0.5	*32.2*	10.0	0.3	*5.5*	7.3	0.2	1.4	0.1		15.7	0.4	*52.3*	14.1	0.3	*58.4*	5.3	0.3	1.6	0.2		1.0	0.2	*0.8*	0.2	0.2	0.8	0.1
North-west	622	26.8	0.8	*27.3*	11.8	0.4	*4.3*	10.1	0.4	1.1	0.2		12.5	0.6	*54.4*	10.2	0.5	*67.4*	3.8	0.4	2.4	0.4		1.8	0.4	*0.0*	0.7	0.3	1.1	0.2
North-east	2009	27.2	0.5	*25.3*	10.7	0.2	*3.8*	8.4	0.2	1.1	0.1		13.9	0.3	*46.8*	11.5	0.3	*56.9*	4.5	0.2	2.4	0.2		1.7	0.2	*0.3*	0.5	0.2	1.2	0.1
Germany																														
Heidelberg	1087	21.8	0.6	*7.2*	13.3	0.3	*2.4*	11.3	0.3	1.8	0.2		7.4	0.5	*16.8*	4.3	0.4	*27.3*	1.5	0.3	3.1	0.3		0.1	0.3	*12.7*	–	–	0.1	0.2
Potsdam	1063	25.8	0.6	*2.1*	11.6	0.3	*1.5*	10.1	0.3	1.0	0.2		13.2	0.5	*2.7*	2.7	0.4	*9.8*	0.7	0.3	10.5	0.3		0.4	0.3	*1.5*	–	–	0.4	0.2
The Netherlands																														
Bilthoven	1086	24.8	0.6	*11.7*	5.4	0.3	*5.9*	4.1	0.3	1.2	0.2		11.6	0.5	*10.3*	2.5	0.4	*17.2*	0.7	0.3	9.1	0.3		6.3	0.3	*22.6*	4.2	0.2	2.1	0.2
Utrecht	1874	22.2	0.5	*14.7*	5.1	0.3	*3.7*	3.9	0.2	1.2	0.1		11.0	0.4	*12.0*	1.6	0.3	*9.5*	0.6	0.3	9.3	0.2		5.0	0.2	*34.9*	3.7	0.2	1.3	0.1
United Kingdom																														
General population	571	18.6	0.8	*5.0*	5.4	0.5	*2.9*	4.2	0.4	0.8	0.2		7.4	0.6	*7.6*	3.5	0.5	*13.0*	1.2	0.5	3.8	0.4		4.6	0.4	*4.5*	3.0	0.3	1.6	0.2
'Health-conscious'	197	24.7	1.4	*5.7*	5.3	0.8	*2.1*	4.7	0.7	0.5	0.4		16.0	1.1	*8.1*	7.4	0.9	*15.1*	4.1	0.8	8.6	0.6		3.1	0.6	*1.7*	2.1	0.5	1.0	0.4
Denmark																														
Copenhagen	1485	22.3	0.5	*5.8*	6.3	0.3	*6.4*	3.2	0.2	2.8	0.1		3.7	0.4	*10.8*	2.2	0.3	*13.1*	1.1	0.3	1.5	0.2		11.6	0.2	*3.4*	8.3	0.2	3.2	0.1
Aarhus	510	22.7	0.9	*8.8*	6.2	0.5	*16.5*	2.7	0.4	3.3	0.2		3.7	0.7	*10.8*	1.8	0.6	*9.0*	0.9	0.5	1.9	0.4		11.9	0.4	*5.0*	9.3	0.3	2.6	0.2
Sweden																														
Malmö	1711	25.8	5.0	*13.6*	4.8	0.3	*26.1*	1.5	0.2	3.3	0.1		9.5	0.4	*20.0*	1.8	0.3	*44.6*	0.7	0.3	7.4	0.2		10.6	0.2	*1.9*	8.8	0.2	1.9	0.1
Umeå	1574	24.6	0.5	*8.5*	4.4	0.3	*20.1*	1.3	0.2	3.1	0.1		7.8	0.4	*11.7*	2.0	0.3	*22.1*	0.5	0.3	5.8	0.2		11.8	0.2	*2.5*	10.5	0.2	1.3	0.1
Norway																														
South & East	1136	18.3	0.6	*7.1*	5.4	0.3	*7.8*	2.8	0.3	2.5	0.2		9.0	0.5	*8.9*	2.0	0.4	*13.2*	1.7	0.3	7.0	0.3		3.4	0.3	*0.0*	2.0	0.2	1.4	0.1
North & West	662	18.3	0.8	*6.6*	4.7	0.4	*7.9*	2.2	0.4	2.5	0.2		9.1	0.6	*9.0*	1.3	0.5	*16.3*	0.9	0.4	7.9	0.3		3.9	0.4	*0.0*	2.2	0.3	1.7	0.2

SEM – standard error of the mean.
* Adjusted for age as well as for day of the week and season of the 24-hour recall assessment.
† Mixed-fat margarine not available on the market or not consumed.

Table 3b Daily intake of lipids (g lipid day^{-1}, adjusted*) by consumption of added fats and oils, including fats and oils used for sauce preparation and indicating the percentage contribution of sauces to the combined lipid intake, in men from 19 centres across 10 European countries participating in the European Prospective Investigation into Cancer and Nutrition (EPIC) calibration study (24-hour recall)

		Total fats & oils			Animal fats & oils							Pure vegetable fats & oils										Mainly vegetable fats & oils						
					Total			Butter		Dairy cream		Total			Vegetable oils			Olive oil		Vegetable margarine		Total			Mixed-fat margarine		Mayonnaise	
		g lipid day^{-1}			g lipid day^{-1}			g lipid day^{-1}		g lipid day^{-1}		g lipid day^{-1}			g lipid day^{-1}			g lipid day^{-1}		g lipid day^{-1}		g lipid day^{-1}			g lipid day^{-1}		g lipid day^{-1}	
Country and centre	*n*	Mean	SEM	*% from sauces*	Mean	SEM	*% from sauces*	Mean	SEM	Mean	SEM	Mean	SEM	*% from sauces*	Mean	SEM	*% from sauces*	Mean	SEM	Mean	SEM	Mean	SEM	*% from sauces*	Mean	SEM	Mean	SEM
Greece																												
Greece	1312	51.2	0.8	*4.9*	0.6	0.4	*0.4*	0.2	0.4	0.0	0.2	48.3	0.6	*5.2*	46.4	0.5	*5.1*	43.0	0.4	1.9	0.4	0.5	0.4	*0.0*	–†	–	0.5	0.2
Spain																												
Granada	214	45.2	1.9	*1.1*	1.6	1.1	*0.0*	1.4	0.9	0.2	0.4	41.6	1.5	*1.2*	39.3	1.1	*2.5*	35.7	1.1	2.3	1.0	1.9	1.1	*0.0*	–	–	1.9	0.5
Murcia	243	42.4	1.8	*0.7*	1.6	1.0	*0.0*	1.1	0.9	0.1	0.4	39.3	1.4	*0.8*	38.2	1.0	*2.5*	31.1	1.0	1.1	0.9	1.5	1.0	*0.1*	–	–	1.5	0.5
Navarra	444	49.6	1.3	*1.6*	0.2	0.7	*0.0*	0.2	0.6	0.0	0.3	48.0	1.0	*1.7*	47.3	0.8	*1.9*	36.8	0.7	0.7	0.7	1.4	0.8	*0.0*	–	–	1.4	0.4
San Sebastian	490	46.4	1.3	*4.7*	0.6	0.7	*0.0*	0.3	0.6	0.2	0.3	44.8	1.0	*4.9*	43.9	0.7	*6.5*	25.4	0.7	0.9	0.6	1.2	0.7	*0.5*	–	–	1.4	0.3
Asturias	386	33.1	1.4	*3.6*	0.7	0.8	*0.0*	0.3	0.7	0.2	0.3	31.5	1.1	*3.8*	29.5	0.8	*4.7*	22.4	0.8	2.0	0.7	1.0	0.8	*0.1*	–	–	1.0	0.4
Italy																												
Ragusa	168	36.1	2.2	*33.6*	0.9	1.2	*10.7*	0.6	1.0	0.1	0.4	34.7	1.6	*34.7*	34.7	1.3	*34.7*	30.8	1.2	0.0	1.1	0.0	1.2	*0.0*	–	–	0.0	0.6
Florence	271	36.2	1.7	*9.7*	3.0	0.9	*5.1*	2.6	0.8	0.2	0.3	32.3	1.3	*10.2*	32.2	1.0	*10.4*	30.3	1.0	0.1	0.9	0.5	1.0	*0.5*	–	–	0.5	0.4
Turin	677	30.1	1.1	*6.6*	2.2	0.6	*6.2*	1.6	0.5	0.3	0.2	26.2	0.8	*6.9*	25.9	0.6	*9.1*	22.6	0.6	0.2	0.5	1.2	0.6	*0.2*	–	–	1.2	0.3
Varese	328	31.9	1.6	*27.2*	4.1	0.8	*13.9*	3.5	0.7	0.3	0.3	26.6	1.2	*30.4*	26.1	0.9	*31.3*	23.0	0.9	0.5	0.8	0.3	0.9	*0.0*	–	–	0.3	0.4
Germany																												
Heidelberg	1033	28.4	0.9	*6.0*	16.4	0.5	*2.2*	14.6	0.4	1.7	0.2	9.5	0.7	*13.2*	4.7	0.5	*26.1*	1.3	0.5	4.8	0.4	0.2	0.5	*1.8*	–	–	0.2	0.2
Potsdam	1235	45.6	0.8	*1.5*	20.1	0.4	*0.7*	17.7	0.4	1.0	0.2	24.0	0.6	*2.3*	2.7	0.5	*17.5*	0.4	0.4	21.3	0.4	0.5	0.5	*0.2*	–	–	0.5	0.2
The Netherlands																												
Bilthoven	1024	37.2	0.9	*10.8*	5.8	0.5	*3.0*	4.3	0.4	1.4	0.2	19.5	0.7	*7.7*	2.9	0.5	*14.2*	0.7	0.5	16.6	0.5	9.1	0.5	*24.1*	6.4	0.5	2.7	0.2
United Kingdom																												
General population	404	31.4	1.4	*3.4*	8.1	0.8	*1.3*	6.6	0.7	1.1	0.3	13.6	1.1	*6.1*	5.1	0.8	*10.7*	1.3	0.8	8.5	0.7	7.3	0.8	*1.8*	5.7	0.7	1.6	0.4
'Health-conscious'	114	33.0	2.6	*5.3*	6.7	1.4	*0.7*	6.4	1.3	0.3	0.5	22.7	2.0	*7.4*	8.5	1.5	*19.1*	3.9	1.5	14.2	1.3	3.4	1.5	*0.1*	1.4	1.3	2.0	0.7
Denmark																												
Copenhagen	1356	36.9	0.8	*5.7*	8.4	0.4	*5.7*	5.4	0.4	2.2	0.2	5.7	0.6	*8.8*	2.6	0.4	*12.6*	1.3	0.4	3.1	0.4	21.3	0.4	*5.2*	14.8	0.4	6.6	0.2
Aarhus	567	38.7	1.2	*7.8*	8.7	0.6	*13.3*	4.6	0.6	3.7	0.2	6.2	0.9	*8.2*	1.8	0.7	*13.6*	0.8	0.7	4.4	0.6	22.6	0.7	*5.3*	18.6	0.6	4.0	0.3
Sweden																												
Malmö	1421	37.4	0.8	*7.5*	4.6	0.4	*21.3*	1.8	0.4	2.7	0.2	13.4	0.6	*12.7*	1.9	0.5	*28.1*	0.5	0.4	11.2	0.4	17.5	0.4	*0.6*	15.1	0.4	2.4	0.2
Umeå	1344	40.7	0.8	*3.7*	6.3	0.4	*9.6*	3.3	0.4	3.1	0.2	11.6	0.6	*6.0*	1.5	0.4	*18.3*	0.4	0.4	10.1	0.4	21.2	0.4	*0.5*	19.8	0.4	1.4	0.2

SEM – standard error of the mean.
* Adjusted for age as well as for day of the week and season of the 24-hour recall assessment.
† Mixed-fat margarine not available on the market or not consumed.

Table 4a Daily intake of lipids (percentage of total energy intake (% en); percentage of total lipid intake (% lipid); adjusted*) by consumption of added fats and oils, including fats and oils used for sauce preparation, in women from 27 centres across 10 European countries participating in the European Prospective Investigation into Cancer and Nutrition (EPIC) calibration study (24-hour recall)

		Total fats & oils				Animal fats								Pure vegetable fats & oils										Mainly vegetable fats & oils							
						Total				Butter		Dairy cream		Total				Vegetable oils		Olive oil		Vegetable margarine		Total				Mixed-fat margarine		Mayon-naise	
		% en		% lipid		% en		% lipid		% en		% en		% en		% lipid		% en		% en		% en		% en		% lipid		% en		% en	
Country and centre	*n*	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Greece																															
Greece	1374	21.8	0.2	48.8	0.5	0.3	0.1	0.7	0.3	0.2	0.1	0.0	0.1	20.9	0.2	46.7	0.4	19.9	0.2	18.4	0.1	1.0	0.1	0.2	0.1	0.5	0.3	–†	–	0.2	0.1
Spain																															
Granada	300	15.3	0.5	38.8	1.0	0.5	0.3	1.2	0.7	0.4	0.2	0.1	0.1	14.4	0.4	36.4	0.9	12.9	0.3	11.6	0.3	1.5	0.2	0.4	0.2	1.1	0.5	–	–	0.4	0.1
Murcia	304	17.1	0.5	43.4	1.0	0.6	0.3	1.4	0.7	0.2	0.2	0.1	0.1	16.1	0.4	40.8	0.9	15.3	0.3	12.3	0.3	0.8	0.2	0.4	0.2	1.2	0.5	–	–	0.4	0.1
Navarra	271	16.8	0.5	39.5	1.1	0.3	0.3	0.7	0.7	0.2	0.2	0.1	0.1	16.0	0.4	37.9	1.0	15.4	0.3	12.9	0.3	0.6	0.2	0.5	0.2	1.0	0.6	–	–	0.4	0.1
San Sebastian	244	15.7	0.5	39.4	1.2	0.3	0.3	0.8	0.7	0.2	0.2	0.1	0.1	14.9	0.4	37.7	1.0	14.1	0.4	10.1	0.3	0.9	0.2	0.5	0.2	1.0	0.6	–	–	0.5	0.1
Asturias	324	10.7	0.4	29.3	1.0	0.6	0.3	1.6	0.6	0.4	0.2	0.2	0.1	9.8	0.4	26.9	0.9	9.0	0.3	6.8	0.3	0.8	0.2	0.3	0.2	0.8	0.5	–	–	0.3	0.1
Italy																															
Ragusa	138	13.3	0.7	39.3	1.5	0.4	0.4	1.2	1.0	0.2	0.3	0.2	0.2	12.9	0.6	38.0	1.4	12.8	0.5	11.0	0.4	0.1	0.3	0.0	0.3	0.0	0.8	–	–	0.0	0.2
Naples	403	11.9	0.4	37.2	0.9	0.5	0.2	1.6	0.6	0.3	0.2	0.1	0.1	11.3	0.3	35.3	0.8	11.2	0.3	9.0	0.3	0.1	0.2	0.0	0.2	0.2	0.5	–	–	0.0	0.1
Florence	785	12.2	0.3	37.8	0.6	1.0	0.2	2.9	0.4	0.9	0.1	0.1	0.1	10.9	0.2	34.1	0.6	10.9	0.2	10.2	0.2	0.0	0.1	0.1	0.1	0.4	0.3	–	–	0.1	0.1
Turin	392	12.1	0.4	38.1	0.9	0.8	0.2	2.5	0.6	0.6	0.2	0.1	0.1	10.8	0.3	34.3	0.8	10.7	0.3	8.9	0.3	0.1	0.2	0.4	0.2	1.1	0.5	–	–	0.4	0.1
Varese	794	10.8	0.3	34.0	0.6	1.4	0.2	4.6	0.4	1.3	0.1	0.1	0.1	9.1	0.2	28.6	0.6	9.0	0.2	7.9	0.2	0.1	0.1	0.1	0.1	0.4	0.3	–	–	0.1	0.1
France																															
South coast	612	13.3	0.3	33.1	0.7	4.1	0.2	10.4	0.5	3.0	0.2	0.5	0.1	8.3	0.3	20.4	0.6	7.5	0.2	3.7	0.2	0.8	0.2	0.7	0.2	1.8	0.4	0.3	0.1	0.4	0.1
South	1396	12.3	0.2	32.4	0.5	4.5	0.1	11.9	0.3	3.3	0.1	0.6	0.1	7.1	0.2	18.8	0.4	6.4	0.1	2.5	0.1	0.7	0.1	0.4	0.1	1.1	0.2	0.1	0.1	0.4	0.1
North-west	622	12.2	0.3	31.9	0.7	5.2	0.2	13.6	0.5	4.5	0.2	0.5	0.1	5.9	0.3	15.5	0.6	4.8	0.2	1.7	0.2	1.1	0.2	0.8	0.2	2.1	3.7	0.4	0.1	0.5	0.1
North-east	2009	12.0	0.2	31.0	0.4	4.7	0.1	12.0	0.3	3.7	0.1	0.5	0.0	6.2	0.1	16.1	0.4	5.1	0.1	2.0	0.1	1.1	0.1	0.7	0.1	1.9	0.2	0.2	0.1	0.5	0.0
Germany																															
Heidelberg	1087	10.4	0.2	29.2	0.6	6.2	0.1	16.8	0.4	5.3	0.1	0.8	0.1	3.7	0.2	10.7	0.5	2.1	0.2	0.7	0.2	1.6	0.1	0.1	0.1	0.2	0.3	–	–	0.1	0.1
Potsdam	1063	12.8	0.2	34.3	0.6	5.6	0.1	14.3	0.4	4.9	0.1	0.5	0.1	6.7	0.2	18.5	0.5	1.4	0.2	0.4	0.2	5.3	0.1	0.2	0.1	0.5	0.3	–	–	0.2	0.1
The Netherlands																															
Bilthoven	1086	11.4	0.2	30.1	0.6	2.3	0.1	5.7	0.4	1.7	0.1	0.5	0.1	5.5	0.2	15.1	0.5	1.3	0.2	0.5	0.2	4.2	0.1	2.8	0.1	7.5	0.3	2.0	0.1	0.9	0.1
Utrecht	1874	9.9	0.2	26.4	0.4	2.1	0.1	5.4	0.3	1.6	0.1	0.5	0.0	5.1	0.2	14.0	0.4	0.7	0.1	0.2	0.1	4.4	0.1	2.2	0.1	5.9	0.2	1.7	0.1	0.5	0.0
United Kingdom																															
General population	571	9.3	0.3	26.6	0.8	2.7	0.2	7.3	0.5	2.2	0.2	0.4	0.1	3.7	0.3	11.1	0.7	1.7	0.2	0.6	0.2	2.0	0.2	2.3	0.2	6.6	0.4	1.4	0.1	0.9	0.1
'Health-conscious'	197	11.4	0.6	31.5	1.3	2.2	0.3	5.8	0.8	2.0	0.3	0.2	0.2	7.6	0.5	21.0	1.1	3.5	0.4	1.9	0.4	4.1	0.3	1.5	0.3	4.5	0.7	1.0	0.2	0.5	0.1
Denmark																															
Copenhagen	1485	9.9	0.2	28.6	0.5	2.7	0.1	7.8	0.3	1.4	0.1	1.2	0.1	1.7	0.2	5.4	0.4	1.1	0.1	0.5	0.1	0.7	0.1	5.1	0.1	14.4	0.2	3.8	0.1	1.3	0.1
Aarhus	510	9.6	0.4	27.1	0.8	2.3	0.2	6.5	0.5	1.0	0.2	1.2	0.1	1.7	0.3	5.3	0.7	0.8	0.2	0.4	0.2	0.9	0.2	5.2	0.2	14.3	0.4	4.1	0.1	1.1	0.1
Sweden																															
Malmö	1711	12.2	0.2	30.9	0.4	2.2	0.1	5.4	0.3	0.6	0.1	1.5	0.1	4.5	0.2	11.5	0.4	0.7	0.1	0.2	0.1	3.7	0.1	5.1	0.1	12.8	0.2	4.2	0.1	0.8	0.1
Umeå	1574	11.3	0.2	30.3	0.5	2.0	0.1	5.3	0.3	0.6	0.1	1.4	0.1	3.6	0.2	10.1	0.4	0.9	0.1	0.2	0.1	2.7	0.1	5.4	0.1	14.2	0.2	4.8	0.1	0.6	0.1
Norway																															
South & East	1136	8.3	0.2	22.5	0.5	2.3	0.1	6.0	0.3	1.2	0.1	1.1	0.1	4.2	0.2	11.7	0.5	1.0	0.2	0.9	0.2	3.2	0.1	1.5	0.1	4.0	0.3	0.9	0.1	0.6	0.1
North & West	662	8.3	0.3	22.6	0.7	1.9	0.2	5.1	0.4	0.9	0.2	1.1	0.1	4.4	0.3	12.0	0.6	0.8	0.2	0.5	0.2	3.6	0.1	1.8	0.1	4.8	0.4	1.0	0.1	0.8	0.1

SEM – standard error of the mean.
* Adjusted for age as well as for day of the week and season of the 24-hour recall assessment.
† Mixed-fat margarine not available on the market or not consumed.

Table 4b Daily intake of lipids (percentage of total energy intake (% en); percentage of total lipid intake (% lipid); adjusted*) by consumption of added fats and oils, including fats and oils used for sauce preparation, in men from 19 centres across 10 European countries participating in the European Prospective Investigation into Cancer and Nutrition (EPIC) calibration study (24-hour recall)

		Total fats & oils				Animal fats								Pure vegetable fats & oils										Mainly vegetable fats & oils							
						Total				Butter		Dairy cream		Total				Vegetable oils		Olive oil		Vegetable margarine		Total				Mixed-fat margarine		Mayon-naise	
		% en		% lipid		% en		% lipid		% en		% en		% en		% lipid		% en		% en		% en		% en		% lipid		% en		% en	
Country and centre	*n*	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Greece																															
Greece	1312	21.5	0.2	50.1	0.5	0.2	0.1	0.6	0.3	0.0	0.1	0.0	0.0	20.4	0.2	47.5	0.5	19.7	0.2	18.2	0.2	0.8	0.1	0.2	0.1	0.4	0.3	–†	–	0.2	0.1
Spain																															
Granada	214	15.4	0.6	38.4	1.2	0.5	0.3	1.3	0.8	0.5	0.3	0.1	0.1	14.2	0.5	35.5	1.1	13.6	0.4	12.3	0.4	0.7	0.3	0.6	0.3	1.5	0.8	–	–	0.6	0.2
Murcia	243	14.5	0.5	38.6	1.2	0.4	0.3	0.8	0.7	0.3	0.3	0.0	0.1	13.6	0.4	36.4	1.1	13.2	0.3	10.8	0.3	0.4	0.3	0.6	0.3	1.5	0.7	–	–	0.6	0.2
Navarra	444	16.7	0.4	41.8	0.9	0.1	0.2	0.1	0.5	0.1	0.2	0.0	0.1	16.2	0.3	40.5	0.8	16.0	0.3	12.5	0.3	0.2	0.2	0.4	0.2	1.1	0.5	–	–	0.4	0.1
San Sebastian	490	14.4	0.4	37.0	0.8	0.2	0.2	0.5	0.5	0.1	0.2	0.1	0.1	13.8	0.3	35.6	0.8	13.5	0.2	8.0	0.2	0.3	0.2	0.4	0.2	0.9	0.5	–	–	0.4	0.1
Asturias	386	10.7	0.4	29.5	0.9	0.2	0.2	0.5	0.6	0.1	0.2	0.1	0.1	10.2	0.3	28.1	0.8	9.6	0.3	7.3	0.3	0.6	0.2	0.3	0.2	0.8	0.6	–	–	0.3	0.1
Italy																															
Ragusa	168	12.1	0.6	39.5	1.4	0.3	0.4	1.3	0.9	0.2	0.3	0.0	0.1	11.6	0.5	37.7	1.3	11.5	0.4	10.4	0.4	0.1	0.3	0.0	0.4	0.0	0.9	–	–	0.0	0.2
Florence	271	12.2	0.5	39.7	1.1	0.9	0.3	2.9	0.7	0.8	0.3	0.1	0.1	10.9	0.4	35.8	1.0	10.9	0.3	10.3	0.3	0.0	0.3	0.2	0.3	0.5	0.7	–	–	0.2	0.1
Turin	677	11.0	0.3	38.2	0.7	0.7	0.2	2.2	0.4	0.5	0.2	0.1	0.1	9.7	0.3	34.1	0.6	9.6	0.2	8.3	0.2	0.1	0.2	0.4	0.2	1.1	0.4	–	–	0.4	0.1
Varese	328	10.3	0.5	34.4	1.0	1.3	0.3	4.3	0.6	1.1	0.2	0.1	0.1	8.7	0.4	28.7	0.9	8.6	0.3	7.7	0.3	0.1	0.2	0.1	0.3	0.2	0.6	–	–	0.1	0.1
Germany																															
Heidelberg	1033	10.4	0.3	28.6	0.6	5.6	0.1	14.9	0.4	5.1	0.1	0.5	0.1	3.9	0.2	11.0	0.5	2.0	0.2	0.6	0.2	1.9	0.1	0.1	0.1	0.2	0.4	–	–	0.1	0.1
Potsdam	1235	16.1	0.2	39.5	0.5	6.9	0.1	16.2	0.3	6.1	0.1	0.3	0.1	8.7	0.2	21.8	0.5	1.0	0.2	0.2	0.2	7.6	0.1	0.2	0.1	0.4	0.3	–	–	0.2	0.1
The Netherlands																															
Bilthoven	1024	12.5	0.3	31.9	0.6	1.8	0.2	4.3	0.4	1.3	0.1	0.4	0.1	6.9	0.2	18.0	0.5	1.4	0.2	0.6	0.2	5.5	0.1	2.9	0.2	7.3	0.4	2.1	0.1	0.9	0.1
United Kingdom																															
General population	404	11.3	0.4	31.1	0.9	2.8	0.2	7.4	0.6	2.3	0.2	0.4	0.1	5.0	0.3	14.1	0.8	1.8	0.3	0.5	0.3	3.1	0.2	2.6	0.2	7.4	0.6	2.1	0.2	0.6	0.1
'Health-conscious'	114	12.6	0.8	34.8	1.7	2.2	0.4	5.5	1.1	2.0	0.4	0.2	0.2	9.0	0.6	24.9	1.5	3.5	0.5	1.7	0.5	5.5	0.4	1.4	0.4	4.2	1.0	0.5	0.4	0.8	0.2
Denmark																															
Copenhagen	1356	12.2	0.2	33.0	0.5	2.8	0.1	7.4	0.3	1.7	0.1	0.8	0.0	2.0	0.2	5.9	0.4	0.9	0.1	0.5	0.1	1.1	0.1	6.9	0.1	18.5	0.3	4.8	0.1	2.1	0.1
Aarhus	567	12.5	0.3	33.6	0.8	2.6	0.2	6.9	0.5	1.4	0.2	1.1	0.1	2.1	0.3	5.9	0.7	0.7	0.2	0.3	0.2	1.4	0.2	7.4	0.2	19.9	0.5	6.2	0.2	1.2	0.1
Sweden																															
Malmö	1421	13.5	0.2	33.4	0.5	1.6	0.1	3.9	0.3	0.6	0.1	1.0	0.0	4.7	0.2	11.8	0.5	0.4	0.2	0.0	0.1	4.2	0.1	6.5	0.1	15.9	0.3	5.6	0.1	0.8	0.1
Umeå	1344	13.7	0.2	34.4	0.5	2.1	0.1	5.1	0.3	1.0	0.1	1.1	0.0	4.0	0.2	10.2	0.5	0.5	0.1	0.1	0.1	3.5	0.1	7.2	0.1	17.7	0.3	6.7	0.1	0.5	0.1

SEM – standard error of the mean.
* Adjusted for age as well as for day of the week and season of the 24-hour recall assessment.
† Mixed-fat margarine not available on the market or not consumed.

Table 5 Mean adjusted* intake of added fats and oils (g food day^{-1}), as well as mean lipid intake (g lipid day^{-1}) by consumption of added fats and oils including sauces, by age class, smoking and education level, with and without inclusion of total energy intake, in women and men participating in the European Prospective Investigation into Cancer and Nutrition (EPIC) calibration study (24-hour recall)

			Intake of added fats and oils (g food day^{-1})				Lipid intake by added fats and oils, including sauces (g lipid day^{-1})			
			Women		Men		Women		Men	
Factor, model	Women (*n*)	Men (*n*)	Mean†	SEM	Mean†	SEM	Mean†	SEM	Mean†	SEM
AGE (years)										
Not adjusted for energy intake:										
35–<45	2231	1106	30.0^{NS}	0.9	46.6^{NS}	1.6	26.2^{NS}	0.6	39.0^{a}	1.2
45–<55	8597	3953	29.0	0.7	44.0	1.2	25.6	0.5	37.6^{a}	0.9
55–<65	9003	5910	28.9	0.7	44.4	1.1	25.5	0.5	38.0^{a}	0.8
65–74	3092	2062	28.9	0.8	43.1	1.4	25.0	0.6	35.6^{b}	1.0
Adjusted for energy intake:										
35–<45	2231	1106	28.7^{a}	0.8	39.5^{a}	1.4	25.2^{a}	0.6	33.5^{a}	1.0
45–<55	8597	3953	29.2^{a}	0.6	40.7^{a}	1.0	25.7^{a}	0.4	35.1^{a}	0.7
55–<65	9003	5910	29.8^{a,c}	0.6	43.3^{b}	1.0	26.3^{b}	0.4	37.2^{b}	0.7
65–74	3092	2062	30.8^{b,c}	0.7	44.8^{b}	1.2	26.6^{b}	0.5	36.9^{b}	0.9
SMOKING										
Not adjusted for energy intake:										
Never	13 136	4196	29.0^{a}	0.7	43.3^{a}	1.2	25.5^{a}	0.5	36.4^{a}	0.9
In the past	5189	5061	27.3^{b}	0.7	43.1^{a}	1.2	24.2^{b}	0.5	36.5^{a}	0.8
Currently	4135	3558	31.3^{c}	0.8	47.1^{b}	1.2	27.0^{c}	0.5	39.8^{b}	0.9
Adjusted for energy intake:										
Never	13 136	4196	29.0^{a}	0.6	40.9^{a}	1.0	25.5^{a}	0.4	34.5^{a}	0.7
In the past	5189	5061	28.1^{b}	0.6	41.2^{a}	1.0	24.8^{b}	0.5	34.7^{a}	0.7
Currently	4135	3558	31.9^{c}	0.7	44.3^{b}	1.1	27.5^{c}	0.5	37.6^{b}	0.8
EDUCATION										
Not adjusted for energy intake:										
None	964	749	29.4^{NS}	1.0	43.5^{a,c}	1.6	25.6^{a,b}	0.8	37.5^{a}	1.1
Primary school	6221	4344	30.3	0.4	46.5^{b,c}	0.8	26.6^{a}	0.3	40.0^{b}	0.6
Technical school	4276	2913	29.6	0.5	47.6^{b}	0.9	25.9^{a,b}	0.4	40.3^{b}	0.6
Secondary school	6297	2092	28.8	0.4	43.0^{c}	1.0	25.4^{b}	0.3	37.9^{a}	0.7
University degree	4782	2804	29.4	0.5	41.3^{c}	0.9	26.2^{a,b}	0.4	36.0^{c}	0.6
Adjusted for energy intake:										
None	964	749	31.3^{a}	0.9	42.1^{a,c}	1.4	27.1^{a}	0.7	36.4^{a}	1.0
Primary school	6221	4344	31.3^{a}	0.4	44.7^{a}	0.7	27.5^{a}	0.3	38.4^{b,a}	0.5
Technical school	4276	2913	29.9^{b}	0.5	45.1^{a}	0.8	26.1^{b}	0.3	38.4^{b,a}	0.5
Secondary school	6297	2092	28.4^{c}	0.4	41.8^{b,c}	0.8	25.1^{c}	0.3	37.1^{b,a}	0.6
University degree	4782	2804	27.6^{c}	0.4	40.4^{b,c}	0.8	24.8^{c}	0.3	35.4^{c,a}	0.5

SEM – standard error of the mean.
* Additionally adjusted for centre and season.
† Different superscripts indicate significantly different means within gender, factor and model. Vice versa, means with identical superscripts are not significantly different from each other within gender, factor and model; LSD-test, $P < 0.05$. NS – not significant.

the higher age groups showed a lower intake of added fats and oils; however, the opposite is true when energy adjustment was applied.

Discussion

This paper reports quantitative estimates of dietary intake of added fats and oils (including lipids from sauce consumption) as assessed by 24-hour dietary recalls. Owing to the high standardisation of the dietary assessment tool, the results should represent reliable estimates at the group level for comparison between EPIC centres and countries. Systematically, information on fats and oils used for cooking was obtained separately from the food they were applied to. A further strength of this study is its comprehensive descriptive analysis with a complete inclusion of fats and oils used for sauce preparation. This is rarely mentioned in the literature and has therefore often been a matter of speculation. However, it must be emphasised that the results are not representative for the centre areas or the countries (with few exceptions, e.g. Norway).

No correction (e.g. exclusion from the evaluation) for under- and overreporting was made. The recalls were checked for extreme values at the end of each interview by means of the calculated daily energy intake; the correctness of the given food items had to be confirmed by the interviewed person themselves. With respect to underreporting, the extent of bias introduced by neglecting to mention foods or underestimating portion sizes is discussed elsewhere in this supplement[30].

This study provides information on the lipid intake by

consumption of added fats and oils as well as their contribution to total daily lipid and energy intakes. Since a uniform food composition table is not available for Europe, country-specific food composition data were used. As a source of bias, the calculated nutrient data may differ by the food composition table used[24]. This highlights the need for a common European food composition table, which is already under construction[31].

A particular bias may have been introduced by the use of pictures and equivalent portion sizes related to the amount of fat spread on bread. Validation studies from the Swedish and the Dutch EPIC groups demonstrate that, by means of photographs of fats spread on bread, the amount of fat consumed on bread was overestimated[32,33]. Self-spread amounts were lower than the ones estimated by photographs. In terms of sub-groups, each study revealed somewhat different results. In The Netherlands, overestimation was found, especially in women, in butter users and in persons choosing a high amount of spread on bread. In Sweden overestimation was observed in men only and an influence of the type of fat was not seen. Whether overestimation of spread fat intake by means of photographs might be true for the entire EPIC 24-hour recalls is not yet clear. Further insight is expected from the results of similar validation studies already being conducted in Denmark, France and Germany.

For all descriptive papers on food intake as assessed by the 24-hour recalls in EPIC, the same adjustment procedure was applied. We decided to adjust for unbalanced sampling of the 24-hour recalls (distribution over days of the week and seasons) and for age only. Analysis of variance confirmed a significant effect of age and season on the consumption of added fats and oils. As expected, energy intake was found to be strongly correlated with fat and oil consumption. Consequently, the most common way to adjust for energy intake was applied separately, i.e. presenting the intake of lipids as a percentage of total energy intake (Table 4).

One of the most apparent, although expected, results refers to the Mediterranean EPIC centres showing a high total intake of added fats and oils almost exclusively comprising olive oil while animal fat intake was very low ($\leq 3\,g\,day^{-1}$, Table 1). This corresponds well to the described properties of the Mediterranean diet[19,21,34]. The highest olive oil consumption was found in Greece, followed by the Spanish centres (lower mean for women in Asturias) and the Italian centres (lowest mean for Varese), which is also in line with other studies[19,21,35]. Comparing our results with data on the availability of added lipids from the DAFNE databank reveals considerable insights in terms of identifying patterns of lipid preference[23]. As already described[36], the EPIC participants from France revealed a completely different intake pattern of added fats and oils, even on the South coast of France, and do not adhere to the Mediterranean style. French women consistently reported a rather high contribution of fats and oils from animal origin, which was exceeded only in the German centres. However, vegetable oil consumption – about half of which consisted of olive oil – in the French EPIC cohort was found to be much higher than in central or northern European centres.

The German centres were unique in EPIC in terms of a very high intake of animal fats. This fits well with results from German food consumption surveys[37,38]. While the intake of animal fats has been nearly constant over the past 50 years, there appeared to be a slight tendency towards an increase in vegetable oil consumption during the last five years[39]. The strong increase in margarine intake observable in the area of the former GDR after the reunification of Germany led to higher mean intake values of margarine in the Eastern part of Germany as compared with the rest of Germany. The given data demonstrate that this difference remained until 1998 and the described intake figures correspond with earlier reports[38,40]. Calculating a ratio of animal fat to vegetable fat, the German EPIC centres and particularly Heidelberg were at the top of the list, followed by French centres.

In the UK, a special group of so-called 'health-conscious' people was included in the EPIC study. This group included vegans as well as ovo-lacto vegetarians, fish eaters (consuming fish but no meat) and meat eaters. The difference with respect to the 'general population' refers to a somewhat higher total lipid intake by consumption of fats and oils as a consequence of a higher intake of pure vegetable lipids (vegetable oils, margarine); however, no differences in animal fat consumption were apparent. Across EPIC countries, both British cohorts were low in lipid intake from added fats and oils.

The lowest total lipid intake across all EPIC countries was observed for the female Norwegian EPIC participants regardless of the unit used (grams of lipid per day, % energy, % lipid). This might be a consequence of the public health promotion strategy initiated very early to decrease cardiovascular mortality[41–43]. A decrease in the consumption of added fats and oils since the 1960s has also been described for Sweden and Denmark[44].

A relatively high intake of margarine turned out to be a characteristic of the diet of EPIC participants from central and northern European centres. Whereas in Germany only pure vegetable margarine was on the market, the Swedish and Danish EPIC participants in particular reported a fairly high intake of mixed-fat margarine. The amount of animal fat in mixed-fat margarines covers a wide range from very low (e.g. through the addition of buttermilk in the UK) to 70% of the total fat content (e.g. the brand 'Bregott', full fat, which is very common in Sweden and contains 70% of fat as dairy fat and 30% as rapeseed oil). This indicates that, at least in certain EPIC centres, the amount of animal fat provided by consumption of mixed-fat margarines cannot be neglected (although a precise calculation was not possible here).

Trichopoulou and Lagiou[45] suggested a categorisation

of countries according to their per capita intake of dietary lipids (visible, i.e. added fats and oils, and invisible). Adapting this scheme to the intake patterns of added fats and oils (visible lipids) in EPIC would give the following picture. The first group, characterised by 'a high total intake of fats and oils together with a low contribution of animal fat', would best fit with the situation of the EPIC cohorts in Greece and Spain. In Italy total dietary intake of added fats and oils would be judged as 'moderate'. EPIC participants in Germany and France would be described best as being 'moderate in total fat and oil intake and high in animal fats'. All other EPIC countries would more or less be categorised as 'moderate total intake of added fats and oils together with a moderate intake of added fat of animal origin'. The latter holds true only under the assumption that mixed-fat margarines do not provide a substantial contribution to the intake of fats of animal origin; otherwise, Denmark and Sweden would reach the range of the second category.

For a rough evaluation of the fatty acid pattern of the added fats and oils consumed, knowledge of the fat sources of margarine (and non-specified vegetable oils) would be necessary. It seems likely that market prices induce the industry to use and combine the cheaper fat sources unless a certain fat source is specified on the product label. Assuming that sunflower oil and corn oil are among the dominant sources, a rather high provision of linoleic acid (C18:2$n-6$) would be the consequence. Then, EPIC participants from all central and northern European countries would be expected to have a high absolute intake of $n-6$ polyunsaturated fatty acids by consumption of this food group. However, rapeseed oil, which has become a more common lipid source for margarine production during the last decade, is a very good source for α-linolenic acid (C18:3$n-3$), is high in oleic acid (C18:1$n-9$), and is able to modify the $n-6/n-3$ fatty acid ratio in the total diet. On the other hand, olive oil, which is essentially a monounsaturated oil (oleic acid), dominates the Mediterranean countries. The EPIC centres in France were again different with more than 50% of the comparably high vegetable oil intake not provided by olive oil. Marine fats and oils as a source of $n-3$ long-chain polyunsaturated fatty acids in pure preparations were very rarely consumed but sometimes used as a component of margarine in the Nordic countries and in the UK. In the Norwegian EPIC cohort, cod liver oil is frequently consumed as a supplement and therefore was not included in this evaluation[46,47]. The implication is that the present data do not allow intakes of linoleic, α-linolenic and long-chain $n-3$ polyunsaturated fatty acids to be estimated.

In conclusion, the present results demonstrate a rather high variation in dietary intake of added fats and oils over the EPIC centres. This provides the potential for EPIC to elucidate the role of dietary fat in terms of quantity and quality in the aetiology of cancer of different sites, an area that urgently needs scientific input and progress. The suggestion that olive oil intake is of more benefit than other dietary fats and oils in preventing cancer development[48,49] can also be tested.

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