

Variation in intakes of calcium, phosphorus, magnesium, iron and potassium in 10 countries in the European Prospective Investigation into Cancer and Nutrition study

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Background/objectives: Adequate mineral intake is important for the maintenance of bone health, cellular function and general metabolism, and possibly in the aetiology of cancer and other chronic diseases. This study aimed at investigating variation in intakes of selected minerals across 10 European countries participating in the EPIC (European Prospective Investigation into Cancer and Nutrition) study.

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Methods: Nutrient intakes for 36 034 subjects, aged between 35 and 74 years, in 27 centres were obtained using standardized 24-h dietary recall software (EPIC-SOFT). Mean intakes of calcium, phosphorus, magnesium, iron and potassium were calculated by centre and weighted by season and day of the week and were also stratified by age group. The contribution of food groups to total nutrient intake was calculated.

Results: There was clear geographical variability in intakes, with differences ranging from 35% for magnesium to 90% for iron in men and 36% for potassium to 75% for calcium in women, and a twofold difference in sources of haem iron (meat and fish). There was a geographical gradient in iron intake, with higher intakes in Southern than in Northern Europe and also around a twofold north–south gradient in the contribution of fruits and vegetables to potassium intake. Compared with reference intakes, the majority of age groups and centres had intakes above the recommended levels. Dairy foods and products contributed the most to calcium and phosphorus intake in almost all centres. Cereals and cereal products contributed the most to magnesium and iron intakes, except in Greece and Germany.

Conclusions: Intakes of minerals vary substantially throughout Europe, with some geographical variability in their food sources.

Introduction

Minerals are essential nutrients, and adequate intakes are important not only for the maintenance of bone health but also for cellular function and general metabolism. Aspects of mineral metabolism are also implicated in the aetiology of cancer, cardiovascular and other chronic diseases (WHO, 2003; WCRF/AICR, 2007). *In vitro*, calcium has been shown to have a growth-inhibiting effect on gastrointestinal tumour cells (Lamprecht and Lipkin, 2001) and its increased intake shows an inverse association with risk of colorectal cancer (Larsson *et al.*, 2006; WCRF/AICR, 2007). However, its association with risk of other cancers is less clear, and it may even be positively associated with risk of prostate cancer (Rodriguez *et al.*, 2003), although this is debatable (Baron *et al.*, 2005). Iron is an essential nutrient and its inadequate intake can result in severe health consequences, particularly in some vulnerable populations such as young women and children. However, its potential role in catalysing the production of reactive oxygen species *in vivo* has stimulated speculation that higher intakes may be a risk factor for colorectal or other cancers (WCRF/AICR, 2007).

Evidence associating magnesium, potassium and phosphorus intakes with cancer risk is less well established (Folsom and Hong, 2006; Lin *et al.*, 2006; Dai *et al.*, 2007; van den Brandt *et al.*, 2007; Wolf *et al.*, 2007). Higher magnesium intakes have, however, been associated with reductions in systemic inflammation, blood pressure and metabolic syndrome, and hypomagnesemia has been identified in subjects with type II diabetes (Mizushima *et al.*, 1998; Song *et al.*, 2005a, b, 2007; Barbagallo *et al.*, 2007; Larsson and Wolk, 2007). Furthermore, higher potassium intakes have been associated with lower blood pressure and reduced cardiovascular mortality (He and MacGregor, 2008).

Although intakes of minerals are likely to vary throughout Europe, few studies have investigated intakes systematically in individuals using the same methodology, that is, using data from individual estimates of food consumption, in contrast to estimates from food balance sheets, which are

known to overestimate intakes of individuals (FAO, 2007). The purpose of this study was to investigate age- and gender-related dietary intakes of calcium, phosphorus, magnesium, iron and potassium within 27 redefined centres in 10 European countries participating in the EPIC (European Prospective Investigation into Cancer and Nutrition) study. The data presented in this paper are for intakes from food only, as quantitative data from vitamin and mineral supplements were unavailable, although the types of supplements consumed are described elsewhere (Skeie *et al.*, 2009).

Materials and methods

EPIC is an ongoing prospective cohort study designed to investigate the associations between diet, lifestyle and cancer throughout 10 Western European countries: Denmark, France, Germany, Greece, Italy, Norway, Spain, Sweden, The Netherlands and the United Kingdom (Riboli and Kaaks, 1997; Riboli *et al.*, 2002). The cohort comprises ~370 000 women and 150 000 men aged 20–85 years, enrolled between 1992 and 2000. Participants were mostly recruited from the general population residing within defined geographical areas, with some exceptions: female members of a health insurance scheme for state school employees (France), women attending breast cancer screening (Utrecht, the Netherlands), blood donors (centres in Italy and Spain) and a cohort consisting predominantly of vegetarians ('health-conscious' cohort in Oxford, UK) (Riboli *et al.*, 2002). Of the 27 EPIC centres, 19 had both female and male participants, and 8 centres had only female participants.

Data presented in this paper were derived from the EPIC calibration study, for which an 8% stratified random sample (36 994 participants) of the total cohort gave a standardized 24-h dietary recall (24-HDR) interview. A total of 36 034 subjects with 24-HDR data were included in this analysis, after a systematic exclusion of 960 subjects <35 and >74 years of age because of low participation in these age categories. Approval for the study was obtained from the

ethical review boards of the International Agency for Research on Cancer (Lyon, France) and from all local recruiting institutions. All participants provided written informed consent.

Measurements of diet and other lifestyle factors

A computerized interview software program (EPIC-SOFT) was developed specifically for the calibration study (Slimani *et al.*, 2000), which was designed to improve the comparability of dietary data across centres and to partially correct for dietary measurement error arising from centre-specific bias, and random and systematic within-person errors (Ferrari *et al.*, 2004). Previous publications outline in detail the rationale, methodology and population characteristics of the 24-HDR calibration study (Slimani *et al.*, 2002; Ferrari *et al.*, 2004). The 24-HDR data were obtained from face-to-face interviews, except in Norway, where a telephone interview was conducted (Brustad *et al.*, 2003).

Intakes (mg/day) of total calcium, phosphorus, magnesium, potassium and iron were estimated from the 24-HDRs, using country-specific databases that were developed to improve standardization across countries and which, when combined, are referred to as the ENDB (EPIC Nutrient Database) (Slimani *et al.*, 2007). Within the ENDB, methods of expression of nutrients and conversion factors were standardized across countries and missing values were imputed (Slimani *et al.*, 2007).

Data on other lifestyle factors, including education level, total physical activity and smoking history in this analysis, were collected at baseline through standardized questionnaires and clinical examinations, and have been described for the calibration sample elsewhere (Riboli *et al.*, 2002; Slimani *et al.*, 2002; Haftenberger *et al.*, 2002a,b; Friedenreich *et al.*, 2007). Data on age, as well as on body weight and height, were self-reported by participants during the 24-HDR interview. The mean time interval between these baseline questionnaire measures and the 24-HDR interview varied by country, from 1 day to 3 years later (Slimani *et al.*, 2002).

Statistical analysis

Data of all participants within centres are presented as means and standard error (s.e.), stratified by gender and study centre and ordered according to geographical location from the south to the north, and these means were adjusted by age and weighted by day and season of recall using generalized linear models (this model is referred to as the 'minimally adjusted model'). The weighting procedure was used to account for differences in the sampling procedures of the 24-HDR interviews that were conducted between centres. Data were also stratified by age groups and these means were weighted for day of the week and season without age adjustment. These minimally adjusted intake data are given in all papers across this supplement to ensure direct comparability.

In addition to the minimally adjusted model, intake data were analysed as fully adjusted models, including the additional covariates energy intake, height and weight. This model is referred to as the 'fully adjusted model' and the data are available in the Appendix (Tables A1–A5). If fewer than 20 persons were represented in a stratum defined by centre, gender and age group, descriptive data were omitted from the tables. The percentage contribution of nutrients by food group to total nutrient intake within a country was calculated.

Statistical analyses were carried out using SAS (version 9.0, SAS Institute, Cary, NC, USA) or STATA v10.0.

Results

Overall, when both genders were considered in the same model, women had significantly lower intakes of all nutrients than did men, after adjusting for centre, age, day of the week and season ($P < 0.001$) (data not shown).

In general, although the results from the fully adjusted and minimally adjusted models differed, the differences were not substantial. The greatest differences between fully and minimally adjusted values were found in Greece: 8.7% for calcium, 8.4% for phosphorus and 8% for iron in men, and 12.3% for calcium, 10.8% for phosphorus and 11% for iron in women (Tables 1a–5a and Appendix).

The results sections that follow describe results from the minimally adjusted models.

Calcium

Nutrients. Mean intakes of calcium in men ranged from 804 mg/day in Ragusa (Italy) to 1190 mg/day in Greece, a difference of 48%. In women, the lowest intakes were also found in Ragusa (620 mg/day) and the highest in Utrecht (the Netherlands) (1086 mg/day), a difference of 75% (Table 1a).

The only significant trends with age, in men, were a reduction in intake in San Sebastian (Spain), Malmö (Sweden) and Florence (Italy), with a non-significant trend towards decreased intake with age in Umeå (Sweden). In women, there were significant trends towards decreased calcium intake with age in Granada (Spain), Malmö (Sweden) and Heidelberg (Germany) and a non-significant trend towards a decrease in Umeå (Sweden).

Foods. The main dietary source of calcium was dairy foods and products in all countries (range: 33–62.4% in men and 38.7–61.8% in women), with the exception of men in Greece, where more calcium was supplied by cereals and cereal products (Table 1b). The variability in the amount of calcium supplied by dairy foods was smaller than that for cereals and cereal products. Across the whole cohort, a greater percentage of calcium was supplied by dairy foods and products in women than in men. However, the

Table 1a Minimally adjusted^a mean daily intake of calcium by centre ordered from south to north, gender and age group

Country and centre	Men										Women															
	All		35–44 years		45–54 years		55–64 years		65–74 years		P _{trend}		N		All		35–44 years		45–54 years		55–64 years		65–74 years		P _{trend}	
	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.
<i>Greece</i>	1311	1190	15	1249	45	1234	31	1235	28	1085	24	0.18	1373	895	11	871	30	989	20	843	20	840	23	0.56		
<i>Spain</i>																										
Granada	214	1100	36	—	—	1091	77	1113	50	1085	83	0.25	300	906	24	956	62	941	40	877	38	856	77	0.03		
Murcia	243	1001	34	1263	107	923	62	1007	48	996	119	0.38	304	956	24	917	48	990	40	982	40	—	—	—	0.65	
Navarra	444	902	25	892	111	923	42	913	36	797	78	0.34	271	894	25	869	66	918	41	884	38	—	—	—	0.37	
San Sebastián	490	1004	24	1072	57	1036	34	999	46	905	122	0.03	244	934	27	913	57	1026	43	869	45	—	—	—	0.79	
Asturias	386	1067	27	1052	103	1038	46	1067	41	1172	74	0.18	324	973	23	964	56	981	37	960	37	1082	85	0.25		
<i>Italy</i>																										
Ragusa	168	804	41	—	—	886	61	729	64	—	—	0.16	138	620	35	601	59	636	66	680	63	—	—	—	0.65	
Naples													403	755	21	775	67	760	33	781	32	623	67	0.25		
Florence	271	868	32	1067	102	888	56	861	46	—	—	0.03	784	725	15	850	50	694	26	712	21	812	58	0.84		
Turin	676	934	21	925	67	940	34	953	29	916	79	0.89	392	765	21	776	66	755	35	782	29	—	—	—	0.26	
Varese	327	997	30	—	—	1048	66	988	35	892	100	0.44	794	768	15	744	47	769	25	792	22	696	44	0.62		
<i>France</i>																										
South coast													620	986	17	—	—	1007	27	989	26	923	35	0.20		
South													1425	906	11	—	—	889	17	908	17	919	25	0.10		
North-East													2059	922	9	—	—	925	14	931	14	874	21	0.39		
North-West													631	864	17	—	—	875	26	846	25	859	40	0.63		
<i>Germany</i>																										
Heidelberg	1034	1016	17	1111	44	1044	26	995	25	—	—	0.28	1087	1025	13	1073	21	1052	23	991	21	—	—	—	0.02	
Potsdam	1233	890	15	951	44	879	31	890	20	913	59	0.59	1061	844	13	858	25	823	25	860	19	916	80	0.29		
<i>The Netherlands</i>																										
Bilthoven	1024	1053	17	1093	33	1098	26	1055	29	—	—	0.11	1086	922	13	977	22	921	20	910	24	—	—	—	0.95	
Utrecht													1870	1086	10	—	—	1055	17	1117	15	1044	19	0.91		
<i>United Kingdom</i>																										
General population	402	1114	27	1134	88	1168	48	1108	49	1043	48	0.19	570	903	17	901	52	918	28	908	31	867	37	0.35		
Health-conscious	114	970	50	—	—	784	82	1001	77	—	—	0.60	197	864	30	935	94	832	48	846	47	965	82	0.79		
<i>Denmark</i>																										
Copenhagen	1356	1058	14	—	—	1030	24	1078	19	1017	73	0.88	1484	919	11	—	—	917	18	913	14	928	51	0.48		
Aarhus	567	1124	22	—	—	1152	32	1117	32	—	—	0.27	510	1026	18	—	—	1079	26	971	26	—	—	—	0.52	
<i>Sweden</i>																										
Malmö	1421	967	15	—	—	1042	43	962	22	892	20	0.03	1711	841	10	—	—	853	21	833	17	809	16	0.04		
Umeå	1344	1124	15	1319	49	1122	27	1103	20	1038	43	0.08	1574	922	10	957	25	922	19	911	16	904	34	0.07		
<i>Norway</i>																										
South and East													1004	799	13	806	31	816	16	802	32	—	—	—	0.81	
North and West													793	791	15	855	34	808	18	722	39	—	—	—	0.11	

Abbreviations: M, mean; s.e., standard error; —, if fewer than 20 persons are present in a certain age group, mean intake is not presented.

^aAdjusted for age (when not stratified for age) and weighted by season and day of recall.

Table 1b Contribution to calcium intake by food group (percentage) and gender

	Men										Women												
	Country					Whole cohort					Country					Whole cohort							
	Greece	Spain	Italy	Germany	The Netherlands	United Kingdom ^a	Denmark	Sweden	Mean	s.d.	Greece	Spain	Italy	France	Germany	The Netherlands	United Kingdom ^a	Denmark	Norway	Sweden	Mean	s.d.	
Potatoes	0.2	0.8	0.6	0.4	0.5	0.3	0.7	0.8	0.5	0.2	0.3	0.6	0.2	0.4	0.3	0.4	0.3	0.5	0.3	0.3	0.3	0.4	0.1
Vegetables	9.0	6.7	9.4	5.7	5.4	3.4	4.6	2.8	5.9	2.4	9.9	7.2	9.6	7.3	6.2	5.6	4.3	5.7	4.4	3.5	6.4	2.2	0.1
Legumes	0.6	0.8	0.2	0.1	0.1	0.2	0	0.1	0.3	0.3	0.5	0.5	0.2	0.1	0	0.1	0.2	0	0	0.1	0.2	0.2	
Fruit	4.4	7.2	8.4	3.7	2.5	1.9	3.5	2.4	4.3	2.4	5.1	7.7	9.5	5.4	4.1	3.4	3.3	5.3	3.7	3.5	5.1	2.1	0.2
Dairy and products	33.0	46.1	52.3	39.9	59.1	44.9	50.8	62.4	48.6	9.7	40.3	57.0	54.8	56.5	38.7	61.8	48.7	47.5	56.7	59.7	52.2	8.0	0.2
Cereals and products	37.4	13.3	11.2	6.7	11.0	28.7	14.4	7.9	16.3	10.9	30.8	8.0	9.0	6.0	5.0	7.8	24.1	13.1	8.8	6.8	11.9	8.6	0.2
Meats and products	1.4	3.4	2.9	2.9	2.5	2.6	3.2	2.5	2.7	0.6	1.0	2.0	2.2	2.2	1.7	1.4	1.7	1.9	3.7	1.9	2.0	0.7	
Fish and products	6.7	4.4	2.3	1.0	0.9	2.1	1.7	1.5	2.6	2.0	4.7	2.8	1.9	1.8	0.7	0.7	1.8	1.5	2.4	1.5	2.0	1.2	
Eggs	0.3	0.8	0.3	0.3	0.3	0.2	0.3	0.3	0.4	0.2	0.3	0.5	0.3	0.4	0.2	0.3	0.3	0.2	0.4	0.3	0.3	0.1	
Fats	0.9	0	0	0.5	0.5	0.3	0.4	1.1	0.5	0.4	0.9	0.1	0	0.2	0.3	0.4	0.2	0.2	0	0.7	0.3	0.3	
Sugars	0.9	1.1	2.1	1.4	2.0	2.5	1.8	2.6	1.8	0.6	1.3	0.9	2.7	1.9	1.8	2.0	2.8	1.9	3.8	3.6	2.3	0.9	
Cakes	0.9	1.3	2.8	2.3	1.5	4.0	1.5	3.8	2.3	1.2	1.6	1.4	3.2	2.0	2.0	1.6	3.8	1.7	2.7	4.1	2.4	1.0	
Beverages, non-alcoholic	1.5	8.4	1.8	28.2	8.4	2.4	10.4	4.3	8.2	8.8	1.5	8.9	2.3	9.9	34.4	10.6	3.7	16.0	8.4	6.2	10.2	9.5	0.2
Alcoholic beverages	1.3	3.1	2.5	3.0	1.9	2.1	3.8	1.8	2.4	0.8	0.3	0.7	0.9	1.2	1.4	1.0	1.1	2.0	1.1	1.8	1.2	0.5	
Sauces	0.8	0.4	2.4	1.8	1.2	2.2	2.1	3.8	1.8	1.1	0.8	0.3	2.1	1.5	1.5	0.9	1.7	1.4	1.9	3.6	1.6	0.9	
Soups	0.2	1.3	0.2	0.8	1.0	0.3	0.3	1.2	0.7	0.5	0.1	0.7	0.2	2.0	0.5	0.9	0.5	0.3	0.8	1.4	0.7	0.6	

Abbreviation: s.d., standard deviation.

^aUK general population only.

The three highest food groups within each country are highlighted in bold.

contribution of cereals and cereal products to calcium intake was substantial in Greece (men 37.4%, women 30.8%) and in the United Kingdom (men 28.7%, women 24.1%), whereas in other countries, the maximum contribution was \approx 14% (Table 1b). In Germany, a major source of calcium was non-alcoholic beverages (men 28.2%, women 34.4%).

In women, in Greece, Italy, France and Germany, vegetables were the third most important source of calcium, contributing between 6.2 and 9.9% of intake, whereas in the UK general population, the third most important source of calcium was cakes (4.8%). However, in men, the contribution of vegetables was less obvious, being of importance only in Greece and Spain, although in the United Kingdom, cakes were also the third most important contributor to intakes (4.0%).

Phosphorus

Nutrients. In men, phosphorus intakes ranged from 1425 mg/day in health-conscious men in the United Kingdom to 2070 mg/day in Greece, a difference of 45%. In women, the lowest intakes were in Ragusa (Italy), 1089 mg/day, and the highest intakes were in Aarhus (Denmark), 1478 mg/day, a difference of 36% (Table 2a). In men, there were significant trends towards a decline in phosphorus consumption with age in Navarra (Spain) and trends towards a decline with age in San Sebastian (Spain), Ragusa (Italy), Florence (Italy), Turin (Italy), the UK general population, Malmö (Sweden) and Umeå (Sweden). In women, there were significant decreases in phosphorus intake by age group in Murcia (Spain), Varese (Italy), Umeå (Sweden) and North and East Norway.

Foods. Overall, the greatest contributors to phosphorus intake were dairy foods and products, cereals and cereal products, and meats and products; and in all countries, in both men and women, this accounted for between \approx 63% (in Spain) and \approx 75% (in Denmark) of intake (Table 2b). Of cereals and cereal products, the percentage contribution to intake was highest in Denmark (men 35.9%, women 37.1%) and lowest in Spain (men 14.2%, women 12.1%). The highest contribution from dairy products was in Greece (men 29.3%, women 33.4%) and the lowest in Germany (men 19.0%, women 24.4%). Meat and meat products also contributed substantially to phosphorus intake, with the highest contributions in men in Spain (28.5%) and in women in France (21.9%), and the lowest contributions in both genders in Greece (men 10.9%, women 9.1%). In both Greece and Spain, the contribution from fish was $>$ 10%.

Alcoholic beverages also contributed to 9.2% of phosphorus intake in men in Germany, 6.1% in the Netherlands and 5.0% in Italy. In Germany and the Netherlands (in men), the greatest contribution within the alcoholic beverages group was from beer (Germany 5.5%, the Netherlands 3.8%), whereas in Italy, it came from wine (3.5%) (data not shown).

Table 2b Contribution to phosphorus intake by food group (percentage) by gender

	Men											Women												
	Whole cohort						Country					Whole cohort						Country						
	Mean	s.d.	Greece	Spain	Italy	Germany	The Netherlands	United Kingdom ^a	Denmark	Sweden	Mean	s.d.	Greece	Spain	Italy	France	Germany	The Netherlands	United Kingdom ^a	Denmark	Norway	Sweden	Mean	s.d.
Potatoes	0.5	1.9	1.4	1.3	1.6	1.2	2.4	2.4	2.4	1.6	0.6	1.0	1.8	0.6	1.4	1.4	1.5	1.0	2.1	1.1	1.0	1.3	0.4	
Vegetables	5.6	4.6	6.5	4.3	3.3	4.8	3.4	3.4	2.8	4.4	1.2	6.4	6.5	7.6	6.0	6.0	4.2	5.8	4.5	3.7	3.9	5.5	1.3	
Legumes	1.0	1.3	0.3	0.2	0.1	0.2	0	0	0.2	0.4	0.5	0.7	0.9	0.4	0.2	0.1	0.1	0.3	0	0	0.1	0.3	0.3	
Fruit	2.6	4.4	4.5	3.3	2.7	2.3	1.7	1.7	1.6	2.9	1.1	3.4	5.7	5.7	4.0	4.7	3.6	3.4	3.0	2.9	2.7	3.9	1.1	
Dairy and products	29.3	19.9	19.3	19.0	21.8	26.1	21.8	21.8	29.8	23.4	4.4	33.4	30.7	23.7	28.5	24.4	29.5	28.3	23.2	25.7	25.7	31.2	27.9	3.5
Cereals and products	27.3	14.2	24.0	24.6	28.4	22.0	35.9	21.6	21.6	24.8	6.3	24.2	12.1	20.6	17.7	25.5	27.1	21.0	37.1	28.4	20.1	23.4	6.8	
Meats and products	10.9	28.5	23.1	21.4	23.1	19.4	18.2	20.4	20.4	20.6	5.0	9.1	21.1	20.8	21.9	16.6	18.1	16.9	14.5	16.3	18.2	17.4	3.7	
Fish and products	16.3	13.1	5.1	3.1	2.1	4.9	5.3	4.9	4.9	6.9	5.0	15.2	10.7	4.7	6.9	3.1	2.3	5.1	5.2	7.1	5.1	6.5	3.8	
Eggs	0.4	1.5	0.6	0.6	0.6	0.6	0.7	0.8	0.7	0.7	0.3	0.5	1.3	0.7	0.8	0.8	0.7	0.7	0.8	0.8	0.9	0.8	0.2	
Fats	0.1	0	0	0.4	0.3	0.4	0.3	0.9	0.3	0.3	0.1	0	0	0.2	0.2	0.3	0.2	0.3	0.2	0	0.6	0.2	0.2	
Sugars	0.7	0.7	1.2	0.9	1.2	1.8	1.0	1.3	1.3	1.1	0.4	1.1	0.7	1.6	1.4	1.3	1.6	2.1	1.2	2.6	2.0	1.6	0.6	
Cakes	0.9	2	3.1	2.9	1.9	4.0	1.8	3.8	3.8	2.6	1.1	1.7	3.2	4.0	3.1	3.6	3.1	3.9	2.2	3.4	4.4	3.3	0.8	
Beverages, non-alcoholic	1.0	0.8	2.2	3.2	1.8	3.8	2.0	1.3	2.0	2.0	1.0	1.3	1.0	3.1	2.3	4.0	2.1	4.8	2.1	2.3	1.6	2.5	1.2	
Alcoholic beverages	1.1	2.7	5.0	9.2	6.1	2.9	2.9	3.0	3.0	4.1	2.6	0.3	0.8	2.2	1.4	2.9	1.2	1.0	1.5	1.1	1.7	1.4	0.7	
Sauces	0.7	0.5	2.4	1.5	0.8	1.8	1.4	3.0	1.4	1.5	0.9	0.7	0.5	2.1	1.3	1.6	0.6	1.7	1.1	1.3	3	1.4	0.8	
Soups	0.2	2.2	0.2	1.2	1.2	0.4	0.3	1.0	1.0	0.8	0.7	0.1	1.5	0.2	1.2	1.1	1.2	0.6	0.4	1.1	1.1	0.9	0.5	

Abbreviation: s.d., standard deviation.

^aUK general population only.

The three highest food groups within each country are highlighted in bold.

In women, the contribution from alcoholic beverages was < 3%.

Magnesium

Nutrients. Intakes in men ranged from 347 mg/day in men in Malmö (Sweden) to 467 mg/day in Heidelberg (Germany), a difference of 34%. In women, intake ranged from 258 mg/day in Greece to 402 mg/day in North-West France, a difference of 52% (Table 3a).

In men, there were significant trends to a decline in intake with increasing age in Navarra (Spain), Potsdam (Germany), the United Kingdom and Umeå (Sweden), and a non-significant trend to a decline with increasing age in San Sebastian (Spain) and Malmö (Sweden). In women, there was a significant decrease with age in Heidelberg (Germany), Copenhagen (Denmark), Aarhus (Denmark) and Umeå (Sweden) and a non-significant trend to a decline in the UK general population cohort.

Foods. Overall, contributions to magnesium intake were greatest from cereals and cereal products, from non-alcoholic beverages, dairy foods and products, meats and products, and from fruits and vegetables (Table 3b).

In men, cereals and cereal products contributed the most to magnesium intake in all countries, except in Germany where non-alcoholic beverages made a greater contribution (in both men and women). In Spanish women, dairy foods and products as well as non-alcoholic beverages contributed more than cereals and cereal products, as did non-alcoholic beverages in France. Overall, except in Greek men and women, non-alcoholic beverages contributed > 10% of intake. The greatest contribution to intake of magnesium from vegetables occurred in Greece. Generally, fruits and vegetables contributed more to magnesium intake in the southern than in the northern countries (Table 3b).

Iron

Nutrients. Generally, in men, mean intakes of total iron were higher in the Spanish centres and in Southern European countries (Greece, Italy and France) than in Northern Europe (the UK general population, Denmark, Sweden and Norway), except in the UK health-conscious cohort. Intakes were lowest in Malmö (Sweden) and highest in San Sebastian (Spain), a difference of 90% for men and 57% for women (Table 4a).

In men, there was a significant trend towards a decrease in iron intake with age in Greece, Turin (Italy), Varese (Italy), Navarra (Spain), Potsdam (Germany) and Umeå (Sweden), and in women in San Sebastian (Spain) and the UK general population. There was a non-significant trend to a decline in intake with age in men in Ragusa (Italy), Turin (Italy) and the UK health-conscious population, and in women in Copenhagen (DK).

Table 3b Contribution to magnesium intake by food group (percentage) by gender

	Men												Women											
	Country						Whole cohort						Country						Whole cohort					
	Greece	Spain	Italy	Germany	The Netherlands	United Kingdom ^a	Denmark	Sweden	Mean	s.d.	Greece	Spain	Italy	France	Germany	The Netherlands	United Kingdom ^a	Denmark	Norway	Sweden	Mean	s.d.		
Potatoes	1.7	3.8	1.6	1.5	2.2	2.2	3.7	7.1	3.0	1.9	3.4	3.4	0.7	2.4	1.4	2.0	1.8	3.0	2.6	2.7	2.3	0.9		
Vegetables	13.8	7.9	9.1	5.4	4.7	5.3	4.3	4.4	6.9	3.3	15.4	9.6	10.5	9.6	7.1	5.8	6.3	5.8	5.0	6.1	8.1	3.2		
Legumes	1.5	1.9	0.4	0.2	0.2	0.4	0	0.2	0.6	0.7	1.3	1.3	0.5	0.2	0.1	0.1	0.4	0	0	0.2	0.4	0.5		
Fruit	6.8	10.9	9.1	6.8	6.7	6.8	3.8	5.4	7.0	2.2	9.1	13.6	11.2	7.6	8.6	8.3	9.7	6.6	7.2	8.7	9.1	2.1		
Dairy and products	8.4	11.3	6.8	6.2	10.2	13.2	9.4	13.9	9.9	2.8	11.1	18.7	9.0	9.1	7.5	13.6	14.1	9.6	10.2	13.9	11.7	3.4		
Cereals and products	42.2	16.4	32.0	22.6	30.9	27.2	33.7	26.1	28.9	7.7	37.4	13.7	25.9	14.7	20.6	29.8	25.9	33.6	31.1	23.5	25.6	7.8		
Meats and products	6.1	13.1	10.0	12.1	11.8	9.2	9.0	10.4	10.2	2.2	5.2	9.3	9.3	8.2	8.2	9.1	7.9	7.2	7.4	8.9	8.1	1.3		
Fish and products	5.0	7.6	2.4	1.5	1.2	2.7	2.3	2.9	3.2	2.1	4.6	6.2	2.3	3.2	1.3	1.3	2.7	3.8	2.9	3.1	1.5	1.5		
Eggs	0.1	0.4	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.3	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1		
Fats	0.1	0	0	0.3	0.1	0.1	0.2	0.3	0.1	0.1	0	0	0	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.1	0.1		
Sugars	1.4	1.0	1.1	1.2	2.3	1.9	1.5	2.0	1.6	0.5	2.1	1.0	1.4	1.9	1.5	2.5	2.1	1.8	3.0	2.6	2.0	0.6		
Cakes	1.2	1.5	2.1	1.8	3.1	1.6	2.5	1.9	1.9	0.6	2.1	2.6	3.1	1.9	2.0	2.3	2.7	2.0	2.8	2.8	2.4	0.4		
Beverages, non-alcoholic	4.2	10.5	14.9	25.1	13.7	14.5	18.1	14.3	14.4	6.0	5.3	14.2	19.7	33.4	33.7	16.7	17.1	20.2	17.7	17.1	19.5	8.5		
Alcoholic beverages	4.0	9.4	7.5	10.6	8.9	7.2	10.5	6.2	8.0	2.3	1.2	2.3	2.8	3.9	3.9	3.0	3.5	6.0	2.4	3.3	3.2	1.3		
Sauces	0.9	1.0	1.8	1.3	1.4	2.1	1.0	2.6	1.5	0.6	0.9	1.2	1.6	1.3	1.2	1.1	1.9	0.8	1.2	2.5	1.4	0.5		
Soups	0.3	3.0	0.3	1.0	1.3	0.4	0.2	1.0	0.9	0.9	0.2	2.2	0.3	1.6	0.8	1.4	0.5	0.3	1.9	1.1	1.0	0.7		

Abbreviation: s.d., standard deviation.

^aUK general population only.

The three highest food groups within each country are highlighted in bold.

Foods. The majority of iron was provided by cereals and cereal products, except for Swedish men and women and Spanish men, for whom meats and products were the greatest provider (Table 4b). In countries in which the principal iron source was cereals and cereal products, the second most important source was meat and products, except in Greece where vegetables were second and in Germany where non-alcoholic beverages were the second most important source.

When iron from meat and fish was combined (haem sources of iron), the lowest percentage contribution was in the United Kingdom (men 18.2%, women 14.5%) and the highest was in Sweden (men 37.0%, women 31.1%), a twofold difference in men and 1.9-fold in women. In all countries, the intake of food sources of haem iron was lower in women than in men.

Unlike the small variability for intake of total iron, there was much more variability in the sources of iron; around a fourfold difference for meat and meat products between intakes in Greece and Sweden in both men and women. However, when the percentage contributions from meat and fish were combined, the differences were around two-fold (between intakes in the United Kingdom and Sweden). In Greece and Spain, vegetables and fish contributed more to iron intake than in the northern countries. In Germany and the Netherlands, non-alcoholic beverages contributed 11–17%, whereas in other countries, the contribution was <5%.

Potassium

Nutrients. In men, the lowest intakes of potassium were found in Greece (3536 mg/day) and the highest in San Sebastian (Spain) (4870 mg/day), a difference of 38%. In women, the lowest intakes were also found in Greece (2730 mg/day) and the highest in Murcia (Spain) (3723 mg/day), a difference of 36% (Table 5a).

There was a significant reduction with age for intakes of potassium in men in Navarra (Spain), Ragusa (Italy), the UK general population and Umeå (Sweden), and non-significant trends towards a decrease with age in Potsdam (Germany). In women, there was a significant increase with age in Navarra (Spain).

Foods. Overall, in men, meat and products, cereals and cereal products, non-alcoholic beverages and vegetables contributed to >12% of intake (Table 5b). In women, five food groups each contributed to >12% of intake: non-alcoholic beverages, vegetables, fruits, dairy foods and products, and cereals and cereal products (Table 5b).

There was some geographical variability in contributions to potassium intake, with a greater percentage contribution from fruit and vegetables in Southern European countries (Greece, Spain and Italy) than in Northern Europe (Germany, the Netherlands, the United Kingdom, Denmark and Sweden), ranging from 14.7% in Sweden to 36.8% in Greece (a 2.5-fold difference) in men, and from 20.3% in Norway to

Table 4a Minimally adjusted^a mean daily intake of iron by centre ordered from south to north, gender and age group

Country and centre	Men											Women														
	All		35-44 years		45-54 years		55-64 years		65-74 years		P _{trend}		N	All		35-44 years		45-54 years		55-64 years		65-74 years		P _{trend}		
	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	N	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	P
<i>Greece</i>	1311	17.8	0.2	18.2	0.6	17.9	0.4	17.8	0.4	17.4	0.3	0.02	1373	12.4	0.1	10.6	0.4	13.0	0.2	12.7	0.2	12.3	0.3	0.43		
<i>Spain</i>																										
Granada	214	16.0	0.5	—	—	16.0	1.0	16.1	0.6	15.3	1.1	0.90	300	10.7	0.3	10.7	0.8	11.3	0.5	10.1	0.5	11.9	0.9	0.62		
Murcia	243	16.7	0.4	18.8	1.4	17.5	0.8	15.9	0.6	16.5	1.5	0.14	304	12.3	0.3	12.4	0.6	12.4	0.5	12.1	0.5	—	—	0.31		
Navarra	444	18.7	0.3	21.0	1.4	19.7	0.5	18.3	0.5	15.9	1.0	0.01	271	11.9	0.3	11.8	0.8	12.1	0.5	11.8	0.5	—	—	0.48		
San Sebastian	490	21.5	0.3	21.6	0.7	22.3	0.4	21.3	0.6	18.9	1.6	0.21	244	14.0	0.3	15.4	0.7	14.6	0.5	13.2	0.5	—	—	0.01		
Asturias	386	19.1	0.3	19.2	1.3	19.6	0.6	18.4	0.5	20.4	0.9	0.62	324	12.7	0.3	13.9	0.7	12.4	0.5	12.8	0.5	12.2	1.0	0.18		
<i>Italy</i>																										
Ragusa	168	14.6	0.5	—	—	15.1	0.8	13.7	0.8	—	—	0.05	138	10.3	0.4	11.4	0.7	9.2	0.8	11.0	0.8	—	—	0.29		
Naples	271	15.9	0.4	15.9	1.3	16.1	0.7	16.6	0.6	—	—	0.32	403	10.6	0.3	13.4	0.8	10.1	0.4	10.5	0.4	10.2	0.8	0.25		
Florence	676	16.2	0.3	15.8	0.9	15.7	0.4	16.6	0.4	17.2	1.0	0.08	392	11.6	0.3	11.8	0.8	11.6	0.3	11.4	0.2	11.0	0.7	0.84		
Turin	327	16.5	0.4	—	—	15.4	0.8	16.7	0.5	18.0	1.3	0.01	794	10.7	0.2	11.1	0.6	10.6	0.3	10.9	0.3	10.2	0.5	0.21		
<i>France</i>																										
South coast													620	12.9	0.2			13.0	0.3	13.1	0.3	12.1	0.4	0.37		
South													1425	12.7	0.1			12.6	0.2	13.1	0.2	11.9	0.3	0.59		
North-East													2059	12.9	0.1			13.0	0.2	13.0	0.2	12.0	0.2	0.36		
North-West													631	12.7	0.2			13.3	0.3	12.0	0.3	12.9	0.5	0.80		
<i>Germany</i>																										
Heidelberg	1034	15.7	0.2	15.9	0.6	15.9	0.3	15.8	0.3	—	—	0.38	1087	12.8	0.2	13.3	0.3	13.0	0.3	12.6	0.3	—	—	0.03		
Potsdam	1233	15.1	0.2	16.4	0.6	15.2	0.4	15.1	0.3	14.0	0.8	0.04	1061	12.2	0.2	12.2	0.3	12.9	0.3	12.2	0.2	11.6	1.0	0.36		
<i>The Netherlands</i>																										
Bilthoven	1024	14.3	0.2	14.8	0.4	14.9	0.3	14.3	0.4	—	—	0.18	1086	11.0	0.2	11.3	0.3	11.4	0.2	10.8	0.3	—	—	0.63		
Utrecht													1870	11.3	0.1			11.4	0.2	11.2	0.2	10.8	0.2	0.12		
<i>United Kingdom</i>																										
General population	402	14.1	0.3	14.3	1.1	15.5	0.6	13.4	0.6	13.0	0.6	0.30	570	11.1	0.2	12.4	0.6	11.8	0.3	10.8	0.4	9.7	0.5	0.01		
Health-conscious	114	17.1	0.6	—	—	17.3	1.0	16.8	1.0	—	—	0.06	197	13.6	0.4	11.4	1.1	13.5	0.6	14.7	0.6	12.1	1.0	0.72		
<i>Denmark</i>																										
Copenhagen	1356	14.5	0.2	—	—	14.3	0.3	14.8	0.2	12.9	0.9	0.52	1484	11.1	0.1			11.4	0.2	10.8	0.2	10.1	0.6	0.06		
Aarhus	567	14.2	0.3	—	—	14.1	0.4	14.5	0.4	—	—	0.42	510	11.4	0.2			11.6	0.3	11.2	0.3	—	—	0.84		
<i>Sweden</i>																										
Malmö	1421	11.3	0.2	12.9	0.6	11.6	0.5	11.0	0.3	10.8	0.3	0.15	1711	8.9	0.1	9.6	0.3	9.6	0.3	8.7	0.2	8.3	0.2	0.12		
Umeå	1344	12.5	0.2	—	—	12.6	0.3	12.3	0.3	12.1	0.6	0.01	1574	9.5	0.1			9.8	0.2	9.3	0.2	9.0	0.4	0.12		
<i>Norway</i>																										
South and East													1004	9.5	0.2	9.7	0.4	9.7	0.2	9.5	0.4			0.12		
North and West													793	9.0	0.2	9.6	0.4	9.3	0.2	8.6	0.5			0.12		

Abbreviations: M, mean; s.e., standard error; —, if fewer than 20 persons are present in a certain age group, mean intake is not presented.

^aAdjusted for age (when not stratified for age) and weighted by season and day of recall.

Table 4b Contribution to iron intake by food group (percentage) by gender

	Men														Women													
	Country							Whole cohort							Country							Whole cohort						
	Greece	Spain	Italy	Germany	The Netherlands	United Kingdom ^a	Denmark	Sweden	Mean	s.d.	Greece	Spain	Italy	France	Germany	The Netherlands	United Kingdom ^a	Denmark	Norway	Sweden	Mean	s.d.						
Potatoes	0.8	2.6	1.4	1.0	2.0	1.8	5.4	4.3	2.4	1.6	1.7	2.6	0.7	1.6	1.0	1.7	1.5	4.5	1.6	1.8	1.9	1.0	1.0					
Vegetables	18.3	8.5	11	8.2	6.0	8.2	6.2	4.3	8.8	4.3	21.7	12.5	13.2	11.7	11.8	7.2	10.3	8.3	5.8	6.2	10.9	4.4	4.4					
Legumes	1.8	2.6	0.5	0.3	0.2	0.6	0.1	0.2	0.8	0.9	1.6	2.2	0.7	0.5	0.2	0.2	0.6	0.1	0.1	0.2	0.6	0.7	0.7					
Fruit	2.8	6.8	8.7	6.9	3.3	2.9	2.5	3.2	4.6	2.4	4.0	10.4	11.4	6.9	9.5	5.1	4.8	4.3	3.9	5.4	6.6	2.7	1.1					
Dairy and products	1.9	2.8	2.4	1.8	0.9	3.0	1.2	2.2	2.0	0.7	2.4	5.3	3.4	3.0	2.2	1.2	3.5	1.3	2.1	2.4	2.7	1.1	1.1					
Cereals and products	39.0	22.3	26.8	27.9	32.8	39.7	39.3	29.4	32.2	6.6	36.8	22.7	27.4	25.3	26.3	31.5	38.9	40.9	38.9	28.1	31.7	6.3	6.3					
Meats and products	8.7	25.6	18.6	24.6	22.9	14.1	23.2	34.5	21.5	7.8	7.2	20.7	17.5	22.9	16.3	17.0	11.1	16.6	23.8	28.3	18.1	5.8	5.8					
Fish and products	14.5	8.5	2.6	1.3	1.6	4.1	2.5	2.5	4.7	4.6	15.1	8.7	2.7	4.8	1.2	1.5	3.4	2.5	2.4	2.8	4.5	4.1	4.1					
Eggs	0.4	1.5	0.6	0.6	0.7	0.7	0.9	1.0	0.8	0.3	0.4	1.4	0.9	0.7	0.6	0.8	0.7	0.9	1.0	1.1	0.9	0.3	0.3					
Fats	0.2	0	0	0.2	0	0.2	0.1	0.4	0.1	0.1	0.2	0	0	0.1	0.1	0	0.2	0.1	0.1	0.3	0.1	0.1	0.1					
Sugars	0.8	0.7	1.6	1.5	5.7	1.6	1.7	2.2	2.0	1.6	1.2	1.0	2.0	2.3	2.0	5.2	1.7	2.0	2.3	2.8	2.3	1.1	1.1					
Cakes	1.0	1.8	3.4	2.7	2.5	5.7	1.7	3.4	2.8	1.4	2.0	3.3	4.8	3.4	3.1	4.1	5.6	2.2	3.2	4.1	3.6	1.0	1.0					
Beverages, non-alcoholic	1.5	0.7	2.5	14.0	10.8	2.7	2.7	2.3	4.7	4.9	2.2	1.5	3.8	4.4	16.6	12.0	3.8	3.9	1.9	3.0	5.3	4.7	4.7					
Alcoholic beverages	5.9	10.2	15.4	3.5	2.6	7.1	9.3	3.5	7.2	4.3	1.7	2.7	6.3	7.1	4.0	4.3	6.6	8.9	5.7	4.4	5.2	2.1	2.1					
Sauces	1.1	0.8	2.9	1.9	1.8	2.4	1.5	3.2	2.0	0.8	1.1	1.0	2.7	1.4	1.9	1.6	2.5	1.2	2.3	3.2	1.9	0.7	0.7					
Soups	0.3	3.0	0.3	1.2	2.7	0.8	0.4	2.0	1.3	1.1	0.2	2.3	0.4	2.4	1.0	2.9	1.1	0.5	1.9	2.4	1.5	0.9	0.9					

Abbreviation: s.d., standard deviation.

^aUK general population only.

The three highest food groups within each country are highlighted in bold.

41.2% in Greece (a twofold difference) in women (see Figures 1a and b). However, the contribution from non-alcoholic beverages was greater in the northern countries, ranging from 3.3% in Spain to 19.8% in Denmark (a sixfold difference) in men, and from 5.2% in Spain to 20.8% in Germany (a fourfold difference) in women. In all countries, the main contributors to potassium intake in the non-alcoholic beverage group were coffee, tea and herbal teas (data not shown).

Discussion

The results of this study indicate clear geographical variability in intakes of calcium, phosphorus, magnesium, potassium and iron. Differences in centre-specific mean intakes ranged from 35% for magnesium to 90% for iron intake for men, and from 36% for potassium to 75% for calcium for women. In contrast to the total iron intake, there was a twofold difference in sources of haem iron (meat and fish) between countries, ranging from 16% in the United Kingdom to 34% in Sweden. In most centres, the majority of iron was supplied by cereals and cereal products, with the exception of Swedish men and women and Spanish men in whom meats and products provided the largest amounts. There was a north–south gradient in total iron intake, with higher intakes in Southern than in Northern Europe. There was also an approximately twofold higher contribution to potassium intake from fruits and vegetables in Southern than in Northern Europe, and a four- to sixfold higher difference in contributions from non-alcoholic beverages in the north than in the south. There were also some statistically significant and non-significant trends towards a decreased consumption of all nutrients with age. Intake of all nutrients was lower in women than in men after taking into account age, geographical and sampling differences.

Intakes for each centre and for each age group were compared with population Reference Nutrient Intakes (RNIs) from the United Kingdom, although in some cases, the values, for instance, for calcium, are the same as those for the European or World Health Organization recommendations (COMA, 1991; EC, 1998; WHO, 2003). The UK population RNI of 700 mg/day for calcium, of 550 mg/day for phosphorus, of 8.7 mg/day for iron and of 3500 mg/day for potassium was used (COMA, 1991). For magnesium, the figures used were 300 mg/day for men ≥ 50 years and 270 mg/day for women (COMA, 1991). If the mean of a group of individuals is lower than the RNI, there is a likelihood that certain individuals within the group will have lower than required intakes (COMA, 1991).

Using RNIs to assess group intakes for comparison purposes, the majority of centres and age groups had mean intakes above the recommended levels, apart from women in a few centres or age groups, and one age group of men, who had intakes below the recommendations. For calcium, all women in Ragusa (Italy) and women aged 45–54 years in

Table 5a Minimally adjusted^a mean daily intake of potassium by centre ordered from south to north, gender and age group

Country and centre	Men												Women											
	All		35–44 years		45–54 years		55–64 years		65–74 years		All		35–44 years		45–54 years		55–64 years		65–74 years		All			
	N	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	N	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	<i>P</i> _{trend}	
<i>Greece</i>	1311	3536	37	3619	113	3646	77	3646	70	3306	60	0.27	1373	2730	29	2593	80	2983	52	2712	53	2474	60	0.63
<i>Spain</i>																								
Granada	214	4113	92	—	—	4261	193	4172	124	3820	208	0.78	300	3192	63	3078	163	3376	106	3084	99	3207	203	0.91
Murcia	243	4444	86	5217	269	4224	155	4438	120	4500	300	0.42	304	3723	63	3670	126	3763	106	3774	104	—	—	0.65
Navarra	444	4176	64	4595	278	4209	107	4192	91	3821	195	0.04	271	3291	66	3086	174	3196	109	3401	101	—	—	0.02
San Sebastian	490	4870	61	4972	144	4910	84	4971	116	4505	306	0.23	244	3703	70	3779	149	3955	114	3525	118	—	—	0.14
Asturias	386	4576	68	4446	258	4472	115	4681	102	4619	185	0.17	324	3483	61	3579	147	3472	99	3520	98	3228	223	0.16
<i>Italy</i>																								
Ragusa	168	3953	104	—	—	4003	154	3840	162	—	—	0.02	138	2965	93	3175	155	2679	174	3159	166	—	—	0.32
Naples	271	4129	82	3939	257	4213	140	4261	116	—	—	0.49	403	3012	54	3572	177	2873	86	3043	84	2932	177	0.29
Florence	676	4111	52	4193	168	4098	87	4116	74	4331	198	0.47	784	3173	39	3181	131	3210	68	3156	54	3116	153	0.19
Turin	327	4308	74	—	—	4347	165	4258	89	4747	250	0.10	794	3194	39	3279	125	3134	65	3300	58	2892	117	0.32
<i>France</i>																								
South coast	1034	3676	42	3656	112	3732	66	3666	62	—	—	0.22	1087	3120	34	3168	57	3202	60	3062	55	—	—	0.42
South	1233	3698	38	3875	110	3697	77	3692	50	3619	149	0.08	1061	3130	34	3077	66	3159	65	3180	49	2923	212	0.51
North-East																								
North-West																								
<i>Germany</i>																								
Heidelberg	1024	4283	43	4416	82	4448	65	4203	73	—	—	0.16	1086	3443	34	3425	59	3514	52	3437	64	—	—	0.31
Potsdam																								
<i>The Netherlands</i>																								
Bilthoven	620	3318	44	—	—	—	—	—	—	—	—		620	3318	44	—	—	3345	72	3380	68	3125	92	0.41
Utrecht	1425	3285	29	—	—	—	—	—	—	—	—		1425	3285	29	—	—	3203	45	3371	46	2932	65	0.81
<i>United Kingdom</i>																								
General population	2059	3369	24	—	—	—	—	—	—	—	—		2059	3369	24	—	—	3304	37	3441	38	3322	55	0.92
Health-conscious	631	3430	44	—	—	—	—	—	—	—	—		631	3430	44	—	—	3430	69	3435	66	3376	105	0.39
<i>Denmark</i>																								
Copenhagen	402	3893	67	4331	220	4028	120	3801	122	3678	122	0.02	570	3325	46	3417	138	3438	75	3354	83	3036	98	0.15
Aarhus	114	4125	126	—	—	—	—	—	—	—	—		114	4125	126	—	—	3493	68	3400	70	—	—	0.10
<i>Sweden</i>																								
Malmö	1356	4046	36	—	—	—	—	—	—	—	—		1356	4046	36	—	—	3321	47	3167	37	3106	135	0.16
Umeå	567	4183	56	—	—	—	—	—	—	—	—		567	4183	56	—	—	3493	68	3400	70	—	—	0.10
<i>Norway</i>																								
South and East	1421	3590	37	—	—	—	—	—	—	—	—		1421	3590	37	—	—	3040	54	2929	44	2940	41	0.39
North and West	1344	3815	37	4148	124	3872	68	3754	51	3604	109	0.02	1574	3072	28	3067	67	3128	49	3060	42	2949	88	0.27
<i>Norway</i>																								
South and East	1004	3359	35	—	—	—	—	—	—	—	—		1004	3359	35	—	—	3375	42	3426	85	—	—	0.17
North and West	793	3382	39	—	—	—	—	—	—	—	—		793	3382	39	—	—	3413	47	3395	102	—	—	0.71

Abbreviations: M, mean; s.e., standard error; —, if fewer than 20 persons are present in a certain age group, mean intake is not presented.
^aAdjusted for age (when not stratified for age) and weighted by season and day of recall.

Table 5b Contribution to potassium intake by food group (percentage) by gender

	Men										Women											
	Country					Whole cohort					Country					Whole cohort						
	Greece	Spain	Italy	Germany	The Netherlands	United Kingdom ^a	Denmark	Sweden	Mean	s.d.	Greece	Spain	Italy	France	Germany	The Netherlands	United Kingdom ^a	Denmark	Norway	Sweden	Mean	s.d.
Potatoes	2.3	8.6	4.9	3.7	5.6	4.2	7.9	13.5	6.3	3.6	4.3	7.3	2.0	5.0	3.3	4.6	3.3	6.4	3.2	5.0	4.4	1.6
Vegetables	25.7	12.8	15.2	9.8	8.4	9.4	8.7	7.2	12.2	6.1	26.9	16.8	16.2	13.2	13.2	10.0	11.5	11.6	10.2	9.5	14.3	5.3
Legumes	1.2	1.4	0.4	0.2	0.4	0.3	0	0.2	0.5	0.5	0.9	1.0	0.4	0.3	0.1	0.1	0.3	0	0	0.1	0.3	0.4
Fruit	11.1	15.7	18.6	12.3	7.4	8.8	6.2	7.5	11.0	4.4	14.3	19.4	21.4	15.1	15.7	11.1	12.5	10.5	10.1	11.8	14.2	3.8
Dairy and products	8.6	12.3	6.4	8.0	10.9	15.3	11.3	16.7	12.0	3.6	12.0	19.3	8.8	12.1	9.8	14.2	15.9	11.4	12.9	16.1	13.3	3.2
Cereals and products	19.6	7.3	13.9	12.2	14.9	12.5	18.3	12.5	13.9	3.8	16.1	5.9	11.3	8.2	11.1	13.3	10.9	18.2	14.6	10.9	12.1	3.6
Meats and products	10	16.9	15.3	15.0	16.4	12.2	13.1	13.8	14.1	2.5	7.7	11.7	13.2	13.7	10.3	11.8	10	10.3	11.3	11.4	11.1	1.7
Fish and products	7.6	8.1	3	1.9	1.3	2.9	3.0	3.1	3.9	2.5	7.2	6.4	2.7	4.0	1.8	1.3	2.8	2.8	5.2	3.0	3.7	2.0
Eggs	0.2	0.4	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0
Fats	0	0	0	0.2	0.2	0.3	0.2	0.4	0.2	0.2	0	0	0	0	0.1	0.1	0.3	0.1	0.1	0.2	0.1	0.1
Sugars	0.5	0.6	0.8	1.0	2.0	1.4	1.1	1.3	1.1	0.5	0.9	0.6	1.0	1.3	1.3	2.0	1.5	1.3	2.4	1.6	1.4	0.5
Cakes	0.6	0.8	1.3	1.7	1.2	2.6	1.2	1.9	1.4	0.6	1.1	1.1	1.7	1.9	1.9	1.6	2.2	1.4	1.8	2.0	1.7	0.4
Beverages, non-alcoholic	4.7	3.3	8.7	17.8	17.1	16.5	19.8	14.6	12.8	6.3	6.1	5.1	12.4	12.8	20.8	19.4	18.0	19.1	19.4	16.3	14.9	5.7
Alcoholic beverages	3.8	7.9	7.0	8.1	5.0	4.7	6.8	2.6	5.7	2.0	1.0	1.8	2.4	3.6	3.7	2.2	2.8	4.7	2.2	2.0	2.6	1.1
Sauces	1.0	1.1	3.3	1.7	1.4	2.9	1.3	3	2.0	0.9	0.9	1.1	2.6	1.3	1.7	1.0	2.7	1.1	1.5	3.0	1.7	0.8
Soups	0.2	2.5	0.4	1.7	1.8	0.7	0.5	1.2	1.1	0.8	0.1	1.7	0.5	3.4	1.4	1.7	0.8	0.6	1.3	1.3	1.3	0.9

Abbreviation: s.d., standard deviation.

^aUK general population only.

The three highest food groups within each country are highlighted in bold.

Florence (Italy) had intakes below the UK and WHO RNI of 700 mg/day (COMA, 1991; WHO, 2003). For magnesium, several groups of women had intakes below the RNI: 'all' women in Greece and of the age subgroups 35–44, 55–64 and 65–74 years, 'all' women in Naples (Italy) and of the age subgroups 45–54 and 65–75 years, women in Varese (Italy) aged 65–75 years, women in the UK general population aged 65–75 years and women aged 65–75 years in Malmö (Sweden). For iron, women in Malmö aged 65–74 years were the only group that had intakes lower than the UK RNI. For potassium, 65- to 74-year-old men in Greece and Malmö (Sweden) had intakes below the RNI, whereas in women, all groups had intakes lower than the RNI except for women in Murcia (Spain), San Sebastian (Spain), Utrecht (the Netherlands) and in the UK health-conscious group. For iron, all groups consumed more than the RNI, with intakes ranging from 1.2 to 2.6 times the UK RNI in men, and from 1.0 to 1.8 times the RNI in women.

Compared with data published from different surveys and age groups in populations across eight countries available in the European Nutrition and Health Report (France, Denmark, Germany, Italy, Norway, Spain, Sweden and the United Kingdom), intakes of all the minerals in this study were of a similar order of magnitude for population groups aged ≥ 40 years (Elmadfa and Weichselbaum, 2005), although they were generally higher for magnesium, iron and potassium. However, as the majority of data in the Nutrition and Health Report were derived from diet records (weighed records, food diaries, 24-HDRs) as opposed to frequency methods, and were collected during the same time period, they should be relatively comparable. For Greece, there are very few studies for comparison with EPIC data, but intakes of a population of 951 third-year medical students, assessed by 24-HDR, were in general in agreement but slightly lower than those in our study, although the age group of the students was younger than that of our participants (Mammas *et al.*, 2004). Intake estimates of the Dutch subjects in this study were on a similar scale to those obtained by the Dutch National Food Consumption Survey (1997–1998), but were generally higher for phosphorus, magnesium and iron, and lower for calcium (Voedingscentrum, 1999). The differences we found could be due to either dietary methodologies or the characteristics of the populations, as the EPIC cohorts were not designed to be representative of country populations, or due to variation in the age bands used; hence, it is reassuring to find that our data were broadly similar to those of other studies.

Cereals and cereal products were the major sources of magnesium, iron and potassium in most centres and age groups. Dairy foods and products were, mainly, the major sources of calcium and phosphorus. There were some geographical differences in the contribution of foods to nutrient intakes, with dairy foods supplying most to calcium intakes in all countries except Greece. For the United Kingdom and Greece, a relatively large percentage of calcium was supplied by cereals and cereal products. In the United Kingdom, this is in part due to mandatory supplementation

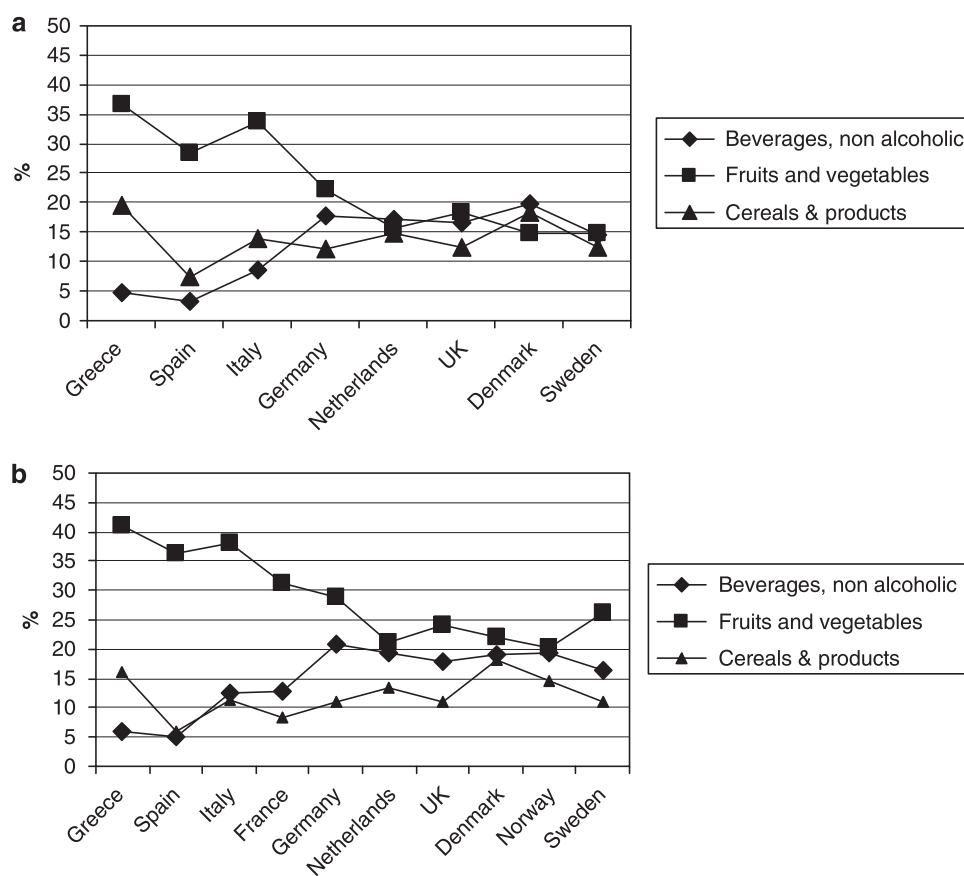


Figure 1 Intakes of potassium from food sources in the EPIC study (a) men and (b) women.

of white flour with calcium carbonate (MAAF, 1998). In Greece, however, fortification of flour is not mandatory; therefore, the large percentage of calcium supplied by cereals may be an overestimation because of the inclusion of values from the UK food composition tables in the Greek National Database used in these analyses (UK food tables were used as there are no national values available) (Slimani *et al.*, 2007). In Germany, non-alcoholic beverages are an important source of calcium and the large contribution to calcium intake may be because of the inclusion of values for tap water or mineral water, which contains minerals, whereas in most food composition databases, the values for beverages or composite foods are calculated assuming water does not contain minerals, but this practice varies between compilers.

The contribution to total potassium intake showed geographical differences, with an approximately twofold larger contribution from fruits and vegetables in Southern than in Northern European countries, and four- to sixfold higher contributions from non-alcoholic beverages in the north than in the south. The contribution of fruits and vegetables to magnesium and iron intake also showed geographical variation, with a greater contribution to intake in the south than in the north.

Within countries, dairy foods and products also made the greatest contribution to phosphorus intakes, followed by cereals and cereal products and meat and products. In Greece, fish and fish products made a greater contribution than did meat and products to phosphorus intake. For magnesium, cereals and cereal products contributed the most to intake, followed by non-alcoholic beverages, dairy foods and products, meat and products, and fruits and vegetables. Cereals and cereal products and then meat and products contributed the most to iron intake, except in Germany and Greece, where non-alcoholic beverages and fish, respectively, provided greater contributions. Variability in the sources of haem iron (meat and fish) to total iron intake was almost twofold, ranging from the lowest contributions in the United Kingdom (16.4%) to the highest in Sweden (34.0%), whereas variability in intakes was smaller (men 90% difference, women 57% difference).

There were some gender differences in the main sources of potassium. In women, non-alcoholic beverages, vegetables, fruits, dairy and cereals and cereal products all contributed to $\geq 12\%$ of intake, whereas, in men, vegetables, cereals and cereal products, meat and products, and non-alcoholic beverages contributed to $> 12\%$ of intake. The contribution

of sources of haem iron in women was lower in all centres than for men, reflecting the tendency for women to eat less meat and fish (Linseisen *et al.*, 2002; Welch *et al.*, 2002).

One major advantage of this study is that these results are comparable across Europe because the same methodology and comprehensively developed food composition tables were used to calculate intakes (Slimani *et al.*, 2007). Another advantage is that the EPIC-SOFT software was designed to standardize interviewing techniques, and the 24-HDR interviews were standardized with interviewers receiving substantial training in the use of the software (Slimani *et al.*, 2000).

A disadvantage of this study is that there was only one 24-HDR per study subject, which limits the accuracy for estimating intakes of individuals. However, 24-HDRs are considered an acceptable method for estimating population mean intakes and for ranking them across centres, as shown by a series of validation studies using independent biomarkers (Slimani *et al.*, 2003; Al-Delaimy *et al.*, 2005; Ferrari *et al.*, 2009; Saadatian-Elahi *et al.*, 2009). Moreover, the contribution of dietary supplements to total intakes has not been taken into account because, although we had data for types of supplements consumed, quantitative data were unavailable (Skeie *et al.*, 2009). However, one study found that the contribution to mineral intakes was small, ranging from 1% of intake for potassium to 16% for calcium (Welch *et al.*, 1998). Also, as the mineral content of drinking and bottled water varies, but is not always comprehensively covered by food composition tables, the contributions from water may also be underestimated.

Apart from leading to a greater understanding of the variations in European intakes of minerals, these data could provide useful information to support the development of European food policies and recommendations, and for decisions on food enrichment programmes.

In conclusion, intakes of minerals vary substantially throughout Europe and there is some geographical variability in the food sources of these nutrients, which may have implications for the aetiology of cancer and other chronic diseases.

Conflict of interest

M Jenab has received grant support from the World Cancer Research Fund. S Bingham has received grant support from MRC Centre. The remaining authors have declared no financial interests.

Acknowledgements

The work described in this paper was carried out with the financial support of the European Commission: Public Health and Consumer Protection Directorate 1993–2004; Research Directorate-General 2005; Ligue contre le Cancer (France); Société 3M (France); Mutuelle Générale de l'Éducation Nationale; Institut National de la Santé et de la Recherche Médicale (INSERM); Institut Gustave Roussy;

German Cancer Aid; German Cancer Research Center; German Federal Ministry of Education and Research; Danish Cancer Society; Health Research Fund (FIS) of the Spanish Ministry of Health; Spanish Regional Governments of Andalucía, Asturias, Basque Country, Murcia and Navarra and the Catalan Institute of Oncology; and ISCIII RETIC (RD06/0020), Spain; Cancer Research UK; Medical Research Council, UK; the Stroke Association, UK; British Heart Foundation; Department of Health, UK; Food Standards Agency, UK; the Wellcome Trust, UK; Greek Ministry of Health; Hellenic Health Foundation; Italian Association for Research on Cancer; Italian National Research Council, Regione Sicilia (Sicilian government); Associazione Iblea per la Ricerca Epidemiologica—ONLUS (Hyblean association for epidemiological research, NPO); Dutch Ministry of Health, Welfare and Sport; Dutch Prevention Funds; LK Research Funds; Dutch ZON (Zorg Onderzoek Nederland); World Cancer Research Fund (WCRF); Swedish Cancer Society; Swedish Research Council; Regional Government of Skane and the County Council of Vasterbotten, Sweden; Norwegian Cancer Society; the Norwegian Research Council and the Norwegian Foundation for Health and Rehabilitation. We thank Sarah Somerville, Nicole Sutty and Karima Abdedayem for assistance with editing and Kimberley Bouckaert and Heinz Freisling for technical assistance.

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Appendix

Table A1 Fully adjusted^a mean daily intake of calcium by centre ordered from south to north, gender and age group

Country and centre	Men										Women																		
	All		35-44 years		45-54 years		55-64 years		65-74 years		P _{trend}		N		All		35-44 years		45-54 years		55-64 years		65-74 years		P _{trend}				
	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.			
Greece	1311	1294	14	1269	40	1294	27	1365	25	1252	22	0.95	1373	1006	10	957	27	1067	17	972	18	996	21	0.94					
Spain																													
Granada	214	1111	32	—	—	1086	68	1126	44	1130	73	0.10	300	977	21	1011	55	957	36	986	33	946	68	0.26					
Murcia	243	981	31	1167	95	870	55	1000	43	1036	106	0.72	304	950	21	881	42	968	35	979	35	—	—	0.70					
Navarra	444	880	23	714	98	822	38	929	32	923	69	0.07	271	910	22	860	58	926	36	910	34	—	—	0.40					
San Sebastian	490	918	22	945	51	906	30	921	41	881	108	0.15	244	918	23	843	50	958	38	913	40	—	—	0.40					
Asturias	386	1034	24	990	91	988	40	1042	36	1145	66	0.09	324	993	20	952	49	993	33	983	33	1121	75	0.14					
Italy																													
Ragusa	168	799	37	—	—	852	54	749	57	—	—	0.51	138	645	31	541	52	725	58	664	56	—	—	0.20					
Naples																													
Florence	271	844	29	904	91	858	49	820	41	—	—	0.25	784	749	13	827	44	712	23	746	18	845	51	0.82					
Turin	676	930	18	864	59	911	31	955	26	929	70	0.19	392	794	19	776	58	775	31	815	26	—	—	0.51					
Varese	327	925	26	—	—	996	58	919	32	790	88	0.10	794	790	13	725	42	782	22	819	20	757	39	0.57					
France																													
South coast																													
South																													
North-East																													
North-West																													
Germany																													
Heidelberg	1034	1019	15	1062	39	1011	23	1009	22	—	—	0.27	1087	1016	11	1018	19	1020	20	1004	19	—	—	0.17					
Potsdam	1233	872	13	833	39	854	27	882	18	912	53	0.00	1061	860	11	851	22	814	22	882	17	943	71	0.19					
The Netherlands																													
Bilthoven	1024	1014	15	975	29	1021	23	1025	26	—	—	0.11	1086	906	11	903	20	889	17	921	21	—	—	0.15					
Utrecht																													
United Kingdom																													
General population	402	1147	24	1079	78	1174	42	1163	43	1126	43	0.61	570	938	15	903	46	920	25	960	28	960	33	0.06					
Health-conscious	114	1031	45	—	—	888	72	1052	68	—	—	0.59	197	842	26	932	82	827	43	799	41	946	72	0.98					
Denmark																													
Copenhagen	1356	1009	13	—	—	986	21	1025	17	997	65	0.82	1484	890	10	—	—	880	16	893	12	949	45	0.22					
Aarhus	567	1046	20	—	—	1061	28	1038	28	—	—	0.27	510	946	16	—	—	980	23	910	23	—	—	0.78					
Sweden																													
Malmö	1421	991	13	—	—	1036	38	1014	20	968	18	0.12	1711	844	9	—	—	840	18	855	15	846	14	0.76					
Umeå	1344	1107	13	1186	44	1092	24	1113	18	1062	38	0.14	1574	916	9	927	22	903	16	922	14	917	30	0.89					
Norway																													
South and East																													
North and West																													

Abbreviations: M, mean; s.e., standard error; —, if a group comprised fewer than 20 persons; mean intake is not presented.

^aAdjusted for age (when not stratified for age), total energy intake, weight, and height and weighted by season and day of recall.

Table A2 Fully adjusted^a mean daily intake of phosphorus by centre ordered from south to north, gender and age group

Country and centre	Men																Women																								
	N	All			35–44 years			45–54 years			55–64 years			65–74 years			N	All	35–44 years			45–54 years			55–64 years			65–74 years			P _{trend}										
		M	s.e.	M	M	s.e.	M	M	s.e.	M	M	s.e.	M	M	s.e.	M			M	s.e.	M	M	s.e.	M	M	s.e.	M	M	s.e.												
<i>Greece</i>	1311	2244	14	2266	42	2482	29	2239	26	2091	23	0.39	1373	1627	9	1618	25	1760	16	1563	17	1531	19	0.41																	
<i>Spain</i>																																									
Granada	214	1600	35	—	—	1621	73	1619	47	1525	78	0.57	300	1245	20	1271	50	1215	33	1251	30	1285	63	0.68																	
Murcia	243	1496	33	1634	101	1419	58	1518	45	1497	113	0.54	304	1251	19	1256	39	1249	33	1249	32	—	—	0.37																	
Navarra	444	1526	24	1436	104	1495	40	1557	34	1537	74	0.12	271	1285	20	1298	54	1271	34	1304	31	—	—	0.31																	
San Sebastian	490	1749	23	1754	54	1741	32	1786	44	1751	115	0.76	244	1367	22	1341	46	1387	35	1381	36	—	—	0.44																	
Asturias	386	1779	26	1770	97	1758	43	1769	38	1880	70	0.23	324	1425	19	1413	45	1441	30	1410	30	1448	69	0.50																	
<i>Italy</i>																																									
Ragusa	168	1503	39	—	—	1523	58	1465	61	—	—	0.80	138	1106	29	1078	48	1141	53	1092	51	—	—	0.24																	
Naples	271	1515	31	1457	97	1572	52	1492	44	—	—	0.70	403	1192	17	1196	55	1169	27	1240	26	1060	55	0.43																	
Florence	676	1503	20	1473	63	1522	33	1506	28	1453	74	0.68	392	1193	17	1210	54	1160	28	1213	24	—	—	0.82																	
Varese	327	1538	28	—	—	1560	62	1545	34	1422	94	0.42	794	1182	12	1177	38	1198	20	1179	18	1144	36	0.32																	
<i>France</i>																																									
South coast																																									
South																																									
North-East																																									
North-West																																									
<i>Germany</i>																																									
Heidelberg	1034	1512	16	1501	42	1494	25	1534	23	—	—	0.16	1087	1183	10	1199	17	1174	19	1178	17	—	—	0.30																	
Potsdam	1233	1437	14	1384	41	1416	29	1463	19	1417	56	0.42	1061	1112	10	1106	20	1086	20	1130	15	1143	65	0.21																	
<i>The Netherlands</i>																																									
Bilthoven	1024	1750	16	1711	31	1776	25	1776	28	—	—	0.50	1086	1328	10	1307	18	1322	16	1371	20	—	—	0.02																	
Utrecht																																									
<i>United Kingdom</i>																																									
General population	402	1634	25	1574	83	1634	45	1611	46	1670	46	0.15	570	1322	14	1284	42	1293	23	1360	25	1337	30	0.19																	
Health-conscious	114	1553	48	—	—	1535	77	1522	73	—	—	0.96	197	1199	24	1194	76	1160	39	1223	38	1243	66	0.25																	
<i>Denmark</i>																																									
Copenhagen	1356	1709	14	—	—	1683	22	1730	18	1661	69	0.80	1484	1344	9	—	—	1335	15	1346	11	1369	42	0.13																	
Aarhus	567	1704	21	—	—	1730	30	1692	30	—	—	0.27	510	1351	15	—	—	1345	21	1357	21	—	—	0.13																	
<i>Sweden</i>																																									
Malmö	1421	1563	14	—	—	1584	40	1573	21	1534	19	0.19	1711	1193	8	—	—	1199	17	1187	14	1190	13	0.50																	
Umeå	1344	1625	14	1644	47	1615	26	1628	19	1610	41	0.25	1574	1267	8	1267	21	1255	15	1282	13	1245	27	0.70																	
<i>Norway</i>																																									
South and East																																									
North and West																																									

Abbreviations: M, mean; s.e., standard error; —, if a group comprised fewer than 20 persons, mean intake is not presented.

^aAdjusted for age (when not stratified for age), total energy intake, weight, and height and weighted by season and day of recall.

Table A3 Fully adjusted^a mean daily intake of magnesium by centre ordered from south to north, gender and age group

Country and centre	Men												Women												P _{trend}
	N	All		35-44 years		45-54 years		55-64 years		65-74 years		P _{trend}	N	All		35-44 years		45-54 years		55-64 years		65-74 years		P _{trend}	
		M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.			M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.		
<i>Greece</i>	1311	387	3	362	8	385	5	391	5	392	4	0.11	1373	292	2	271	6	297	4	297	4	289	5	0.44	
<i>Spain</i>	214	420	7	—	—	430	14	419	9	415	15	0.94	300	330	5	320	13	329	8	333	8	337	16	0.02	
Granada	243	439	6	480	19	427	11	434	9	475	21	0.96	304	340	5	334	10	344	8	338	8	—	—	0.25	
Murcia	444	386	5	379	20	369	8	397	6	397	14	0.24	271	312	5	299	14	317	9	315	8	—	—	0.92	
Navarra	490	423	4	426	10	420	6	429	8	421	22	0.80	244	338	6	334	12	338	9	341	9	—	—	0.65	
San Sebastian	386	422	5	426	18	418	8	420	7	438	13	0.44	324	342	5	338	12	343	8	345	8	325	18	0.48	
Asturias																									
<i>Italy</i>	168	428	7	—	—	415	11	446	11	—	—	0.74	138	284	7	255	12	301	14	307	13	—	—	0.91	
Ragusa	271	361	6	321	18	367	10	368	8	—	—	0.46	403	274	4	272	14	264	7	289	7	252	14	0.70	
Naples	676	370	4	367	12	362	6	377	5	371	14	0.46	784	291	3	286	10	297	5	289	4	290	12	0.84	
Florence	327	345	5	—	—	348	12	344	6	344	18	0.34	392	298	4	281	14	297	7	302	6	—	—	0.23	
Turin													794	277	3	263	10	281	5	280	5	263	9	0.98	
Varese																									
<i>France</i>																									
South coast													620	353	4			362	6	352	5	339	7	0.06	
South													1425	347	2			345	4	355	4	336	5	0.69	
North-East													2059	359	2			361	3	360	3	351	4	0.28	
North-West													631	389	3			395	5	385	5	384	8	0.25	
<i>Germany</i>																									
Heidelberg	1034	469	3	484	8	469	5	464	4	—	—	0.43	1087	398	3	407	5	397	5	392	4	—	—	0.09	
Potsdam	1233	423	3	430	8	429	5	422	4	408	11	0.07	1061	363	3	358	5	363	5	368	4	338	17	0.46	
<i>The Netherlands</i>																									
Bilthoven	1024	391	3	391	6	400	5	384	5	—	—	0.18	1086	306	3	299	5	308	4	313	5	—	—	0.09	
Utrecht													1870	316	2			318	3	317	3	313	4	0.20	
<i>United Kingdom</i>																									
General population	402	367	5	379	16	380	8	355	9	361	9	0.19	570	304	4	306	11	304	6	310	7	294	8	0.41	
Health-conscious	114	460	9	—	—	482	15	455	14	—	—	0.10	197	363	6	304	20	366	10	385	10	335	17	0.59	
<i>Denmark</i>																									
Copenhagen	1356	400	3	402	4	402	4	401	3	371	13	0.32	1484	319	2			322	4	317	3	319	11	0.57	
Aarhus	567	400	4	—	—	402	6	400	6	—	—	0.32	510	325	4			327	5	323	6	—	—	0.16	
<i>Sweden</i>																									
Malmö	1421	359	3	368	9	369	5	365	4	352	4	0.06	1711	283	2	293	5	286	4	282	3	281	3	0.25	
Umeå	1344	366	3	—	—	368	5	365	4	356	8	0.13	1574	293	2			295	4	294	3	287	7	0.32	
<i>Norway</i>																									
South and East													1004	334	3	325	7	333	3	350	7			0.13	
North and West													793	337	3	328	7	341	4	330	8			0.89	

Abbreviations: M, mean; s.e., standard error; —, if a group comprised fewer than 20 persons, mean intake is not presented.
^aAdjusted for age (when not stratified for age), total energy intake, weight, and height and weighted by season and day of recall.

Table A4 Fully adjusted^a mean daily intake of iron by centre ordered from south to north, gender and age group

Country and centre	Men													Women												
	All		35-44 years		45-54 years		55-64 years		65-74 years		P _{trend}		N		All		35-44 years		45-54 years		55-64 years		65-74 years		P _{trend}	
	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.
Greece	1311	19.3	0.2	18.5	0.5	18.7	0.3	19.7	0.3	19.9	0.3	0.04	1373	13.8	0.1	11.8	0.3	14.0	0.2	14.3	0.2	14.2	0.2	14.2	0.2	0.18
<i>Spain</i>																										
Granada	214	15.9	0.4	—	—	15.7	0.8	16.1	0.5	15.9	0.8	0.65	300	11.5	0.2	11.3	0.6	11.3	0.4	11.5	0.4	12.9	0.8	12.9	0.8	0.18
Murcia	243	16.1	0.4	17.1	1.1	16.5	0.6	15.5	0.5	16.8	1.2	0.66	304	11.9	0.2	11.8	0.5	11.9	0.4	11.7	0.4	—	—	—	—	0.23
Navarra	444	18.1	0.3	18.0	1.1	17.9	0.4	18.3	0.4	17.7	0.8	0.73	271	11.9	0.2	11.6	0.6	12.0	0.4	11.9	0.4	—	—	—	—	0.93
San Sebastian	490	20.0	0.3	19.4	0.6	20.1	0.3	19.9	0.5	18.4	1.2	0.44	244	13.7	0.3	14.3	0.6	13.4	0.4	13.8	0.4	—	—	—	—	0.14
Asturias	386	18.4	0.3	18.1	1.1	18.6	0.5	17.8	0.4	19.6	0.8	0.36	324	12.8	0.2	13.6	0.5	12.4	0.4	12.9	0.4	12.7	0.8	12.7	0.8	0.39
<i>Italy</i>																										
Ragusa	168	14.3	0.4	—	—	14.4	0.6	13.7	0.7	—	—	0.26	138	10.3	0.3	10.2	0.6	10.3	0.6	10.5	0.6	—	—	—	—	0.01
Naples	271	15.5	0.3	13.4	1.1	15.6	0.6	15.8	0.5	—	—	0.44	403	10.7	0.2	12.4	0.7	10.2	0.3	11.0	0.3	9.7	0.7	11.3	0.6	0.20
Florence	676	16.0	0.2	14.9	0.7	15.2	0.4	16.5	0.3	17.3	0.8	0.03	392	11.9	0.2	11.6	0.6	11.8	0.3	11.8	0.2	11.3	0.6	11.6	0.2	0.60
Turin	327	15.3	0.3	—	—	14.5	0.7	15.5	0.4	16.2	1.0	0.00	794	10.9	0.1	10.8	0.5	10.6	0.2	11.1	0.2	10.8	0.4	10.8	0.4	0.73
<i>France</i>																										
South coast	620	12.3	0.2	—	—	12.4	0.3	12.4	0.3	12.4	0.3	0.26	12.4	0.3	0.2	12.4	0.3	12.4	0.2	12.8	0.2	11.8	0.8	11.8	0.8	0.44
South	1425	12.2	0.1	—	—	12.1	0.2	12.6	0.2	13.9	0.6	0.51	1061	12.4	0.1	12.2	0.2	12.7	0.2	12.4	0.2	11.8	0.8	11.8	0.8	0.28
North-East	2059	12.1	0.1	—	—	12.0	0.1	12.3	0.1	—	—	0.44	631	12.2	0.2	11.6	0.6	11.8	0.3	11.6	0.2	11.8	0.8	11.6	0.2	0.63
North-West	631	12.2	0.2	—	—	12.6	0.3	11.6	0.2	—	—	0.44	1086	10.8	0.1	10.3	0.2	11.0	0.2	11.0	0.2	10.8	0.4	10.8	0.4	0.97
<i>Germany</i>																										
Heidelberg	1034	15.8	0.2	15.2	0.5	15.5	0.3	16.0	0.3	—	—	0.89	1087	12.7	0.1	12.7	0.2	12.6	0.2	12.8	0.2	—	—	—	—	0.28
Potsdam	1233	14.8	0.2	14.6	0.5	14.8	0.3	15.0	0.2	13.9	0.6	0.51	1061	12.4	0.1	12.2	0.2	12.7	0.2	12.4	0.2	11.8	0.8	11.8	0.8	0.44
<i>The Netherlands</i>																										
Bilthoven	1024	13.8	0.2	13.1	0.3	13.8	0.3	13.8	0.3	—	—	0.44	1086	10.8	0.1	10.3	0.2	11.0	0.2	11.0	0.2	—	—	—	—	0.05
Utrecht	1870	10.8	0.1	—	—	10.8	0.1	—	—	—	—	0.44	1870	10.8	0.1	10.3	0.2	11.0	0.2	10.7	0.1	10.8	0.2	10.8	0.2	0.60
<i>United Kingdom</i>																										
General population	402	14.7	0.3	13.6	0.9	15.6	0.5	14.4	0.5	14.4	0.5	0.81	570	11.7	0.2	12.5	0.5	11.9	0.3	11.6	0.3	11.0	0.4	11.0	0.4	0.01
Health-conscious	114	18.3	0.5	—	—	19.3	0.8	17.9	0.8	—	—	0.15	197	13.4	0.3	11.5	0.9	13.5	0.5	14.2	0.5	14.2	0.5	11.8	0.8	0.84
<i>Denmark</i>																										
Copenhagen	1356	13.8	0.2	—	—	13.7	0.2	14.0	0.2	12.6	0.7	0.47	1484	10.7	0.1	10.3	0.2	11.0	0.2	10.6	0.1	10.5	0.5	10.5	0.5	0.20
Aarhus	567	13.0	0.2	—	—	12.7	0.3	13.3	0.3	—	—	0.58	510	10.2	0.2	10.1	0.3	10.1	0.3	10.3	0.3	—	—	—	—	0.16
<i>Sweden</i>																										
Malmö	1421	11.8	0.2	—	—	11.6	0.4	12.0	0.2	12.1	0.2	0.16	1711	9.1	0.1	9.3	0.2	9.5	0.2	9.1	0.2	8.8	0.2	8.8	0.2	0.04
Umeå	1344	12.3	0.2	10.9	0.5	12.3	0.3	12.5	0.2	12.6	0.4	0.16	1574	9.4	0.1	9.3	0.2	9.6	0.2	9.5	0.2	9.1	0.3	9.1	0.3	0.61
<i>Norway</i>																										
South and East	1004	9.5	0.1	9.3	0.3	9.5	0.2	9.6	0.2	9.5	0.2	0.2	9.5	0.2	0.1	9.0	0.3	9.4	0.2	9.6	0.3	9.6	0.3	9.6	0.3	0.08
North and West	793	9.2	0.1	9.0	0.3	9.4	0.2	8.9	0.4	—	—	0.2	793	9.2	0.1	9.0	0.3	9.4	0.2	8.9	0.4	8.9	0.4	8.9	0.4	0.90

Abbreviations: M, mean; s.e., standard error; —, if a group comprised fewer than 20 persons, mean intake is not presented.

^aAdjusted for age (when not stratified for age), total energy intake, weight, and height and weighted by season and day of recall.

Table A5 Fully adjusted^a mean daily intake of potassium by centre ordered from south to north, gender and age group

Country and centre	Men														Women													
	All		35–44 years		45–54 years		55–64 years		65–74 years		P _{trend}		N		All		35–44 years		45–54 years		55–64 years		65–74 years		P _{trend}			
	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.	M	s.e.		
Greece	1311	3878	29	3688	86	3837	59	4073	53	3851	47	0.41	1373	3068	25	2873	64	3217	42	3099	43	2937	49	0.94				
Spain																												
Granada	214	4120	70	—	—	4211	147	4181	95	3951	158	0.77	300	3396	51	3235	130	3402	85	3411	79	3468	162	0.09				
Murcia	243	4336	66	4849	204	4005	117	4379	91	4581	227	0.84	304	3676	50	3538	101	3666	84	3727	83	—	—	0.22				
Navarra	444	4065	49	3951	211	3827	81	4213	69	4216	149	0.22	271	3321	53	3055	139	3201	87	3453	81	—	—	0.01				
San Sebastian	490	4545	47	4513	110	4435	64	4677	88	4396	232	0.89	244	3634	56	3543	119	3714	91	3654	94	—	—	0.34				
Asturias	386	4429	52	4207	195	4271	87	4565	78	4477	141	0.16	324	3527	49	3522	118	3489	79	3571	78	3339	178	0.40				
Italy																												
Ragusa	168	3902	79	—	—	3854	117	3873	123	—	—	0.07	138	3011	75	2943	124	2946	139	3072	132	—	—	0.95				
Naples	271	4038	62	3383	195	4111	106	4102	88	—	—	0.34	403	3084	44	3373	141	2934	69	3191	67	2870	141	0.31				
Florence	676	4080	39	3986	127	3986	66	4103	56	4356	150	0.09	392	3380	44	3232	139	3345	73	3429	61	—	—	0.86				
Varese	327	4037	57	—	—	4156	125	3999	68	4361	190	0.15	794	3246	31	3215	100	3160	52	3363	47	3055	94	0.72				
France																												
South coast																												
South																												
North-East																												
North-West																												
Germany																												
Heidelberg	1034	3691	32	3504	85	3636	51	3717	47	—	—	0.14	1087	3096	27	3008	45	3105	48	3107	44	—	—	0.79				
Potsdam	1233	3634	29	3479	84	3618	59	3663	38	3606	113	0.30	1061	3176	27	3070	53	3128	52	3239	39	2989	169	0.84				
The Netherlands																												
Bilthoven	1024	4159	33	4033	63	4197	50	4101	56	—	—	0.28	1086	3394	27	3201	47	3419	41	3476	51	—	—	0.06				
Utrecht																												
United Kingdom																												
General population	402	4021	51	4158	167	4060	91	4010	93	3969	92	0.02	570	3443	37	3430	110	3448	60	3529	66	3330	78	0.65				
Health-conscious	114	4371	96	—	—	4310	156	4496	147	—	—	0.87	197	3595	62	3100	196	3633	102	3770	98	3314	172	0.67				
Denmark																												
Copenhagen	1356	3889	28	—	—	3859	45	3920	36	3745	139	0.56	1484	3140	23	—	—	—	—	—	—	—	—	—	0.81			
Aarhus	567	3920	43	—	—	3876	61	3970	61	—	—	0.44	510	3181	39	—	—	—	—	—	—	—	—	—	0.49			
Sweden																												
Malmö	1421	3699	29	—	—	3775	81	3737	43	3737	39	0.34	1711	3001	22	—	—	—	—	—	—	—	—	—	0.34			
Umeå	1344	3773	28	3709	94	3795	52	3802	39	3694	83	0.91	1574	3058	22	2980	53	3076	39	3097	34	2987	70	0.91				
Norway																												
South and East																												
North and West																												

Abbreviations: M, mean; s.e., standard error; —, if a group comprised fewer than 20 persons, mean intake is not presented.

^aAdjusted for age (when not stratified for age), total energy intake, weight, and height and weighted by season and day of recall.