Public Health Nutrition: 16(10), 1768–1781 doi:10.1017/S1368980012004314

Use of food supplements and determinants of usage in a sample Italian adult population

Stefania Giammarioli[1,*], Concetta Boniglia[1], Brunella Carratù[1], Marco Ciarrocchi[1], Flavia Chiarotti[2], Maurizio Mosca[1] and Elisabetta Sanzini[1]

[1]Department of Veterinary Public Health and Food Safety, Istituto Superiore di Sanità, Viale Regina Elena 299, 00161 Rome, Italy: [2]Department of Cell Biology and Neuroscience, Istituto Superiore di Sanità, Rome, Italy

Submitted 23 February 2012: Final revision received 5 July 2012: Accepted 13 August 2012: First published online 1 October 2012

Abstract

Objective: The aims were to collect data on consumption of different food supplements in a sample of the adult Italian population and to characterize users by demographic, physical and health-related characteristics, lifestyle and behaviour.
Design: Cross-sectional survey.
Setting: The study was conducted in 2008 in ten towns of Italy (two towns from each of the five macro-areas: Northwest, Northeast, Centre, South and Islands).
Subjects: Adults (n 10 000) aged ≥18 years were randomly selected and asked to fill in a self-administered questionnaire regarding their use of food supplements and the above variables. The effect of these variables on food supplement use was evaluated by univariate and multivariate logistic regression.
Results: Of the 1723 individuals who returned the questionnaire, 49 % were users of food supplements. A large proportion (54 %) of users used more than one category of food supplement: vitamin and/or mineral supplements were the most used (61 %), followed by supplements with botanicals and botanical extracts (28 %). The results obtained by logistic regression showed that gender, town size, education level, sports practice, regular use of wholemeal cereal-based foods and presence of a low stress level were determinants for the use of food supplements in the examined population. However, these determinants were not shared by all categories of supplements.
Conclusions: The results of this preliminary study highlight that associations between demographic, dietary and lifestyle factors and use of different categories of food supplements differ according to products, and cannot be accounted for simply by dichotomizing individuals as users or non-users.

Keywords
Food supplements
Prevalence
Usage determinants
Italy

The use of food supplements has increased substantially throughout the developed world, including Europe, where these products are regulated by Directive 2002/46/EC[1]. A study undertaken by European Advisory Services for the Directorate-General for Health and Consumers (DG SANCO) of the European Commission estimated the total value of the EU food supplements market in 2005 at about five billion Euros. This comprises food supplements containing vitamins and minerals (50 %), supplements containing 'other substances' (43 %), tonics and bottled nutritive drinks (7 %). The four EU Member States with the largest markets in terms of sales of 'other substances' are Italy in first place, closely followed by Germany, the UK and France[2,3].

Various surveys on the use of food supplements and/or functional foods have been carried out in European countries, in which information about the demographic, physical, lifestyle and health characteristics of food supplement users have also been collected[4–13]. In most cases the variables found to be related to supplement use were age, gender, education, income and lifestyle variables such as drinking, smoking and exercising[4–10]. Significant differences in food consumption were also observed, indicating a tendency for healthier food choices among users of supplements[4,6,11].

In Italy, to our knowledge, no specific surveys have been carried out on this topic. Therefore the first aim of the present study was to collect data on the consumption of food supplements in a sample of the adult population from different areas of Italy and to characterize the users by demographic, physical and health-related characteristics, lifestyle and behaviour. Moreover, the second purpose was also to obtain information on the use of different categories of food supplements and to investigate if the determinants of usage differ according to product as reported in other studies[9,14–17].

These data are important in light of public health issues and to provide indications to the general population.

*Corresponding author: Email stefania.giammarioli@iss.it

Materials and methods

Selection of participants

Sampling was carried out in two stages to select potential participants aged ≥18 years. Specifically, two towns were chosen from each of the five macro-areas of Italy (Northwest, Northeast, Centre, South and Islands), based on data from the National Institute of Statistics (ISTAT) on the resident population at 1 January 2006[18]. The towns selected were: (i) the most populous town of the area ('large') and (ii) a town randomly selected in the area from those with a total population of between 10 000 and 15 000 inhabitants ('small'). The ten selected towns (with the numbers of inhabitants aged ≥18 years) were: Milan (1 125 691) and Ovada (10 256) in the Northwest; Bologna (328 593) and Riva del Garda (12 607) in the Northeast; Rome (2 140 153) and Terranuova Bracciolini (9889) in the Centre; Naples (783 859) and Atri (9281) in the South; Palermo (533 315) and Siniscola (9161) in the Islands. In each town the population was stratified according to sex and age (18–25 years, 26–45 years, 46–65 years, ≥66 years). Adults were then selected randomly from lists of residents of the selected towns, furnished by a society that manages telecommunication, in proportion to the size of each sex-by-age stratum, for a total of 1500 adults from each large town and 500 adults from each small town (overall total: 10 000 adults).

Data collection

A six-page questionnaire was sent in May 2008 to potential participants with a covering letter explaining its purpose and a stamped addressed envelope. A second letter with another copy of the questionnaire was sent 1 month later. To guarantee privacy, questionnaires were assigned a numeric code relative to the town and returned anonymously.

All potential participants were asked to fill in the self-administered questionnaire, providing information on the use of food supplements over the previous 2 years and on some determinants of usage. The definition of food supplements was that used in Directive 2002/46/EC[1]:

> foodstuffs the purpose of which is to supplement the normal diet and which are concentrated sources of nutrients or other substances with a nutritional or physiological effect, alone or in combination, marketed in dose form (such as capsules, pastilles, tablets, pills, ampoules of liquids etc) designed to be taken in measured small unit quantities

and additional clarification was also provided. The present study considered both regular and occasional food supplement users.

The information gathered related to sociodemographic and physical characteristics, lifestyle, health status and dietary habits. The use of eight categories of food supplements (products containing (i) vitamins and/or minerals, (ii) dietary fibre, (iii) fatty acids, (iv) antioxidants, (v) probiotics, (vi) botanicals and botanical extracts, products targeted to (vii) sportsmen or (viii) postmenopausal women) was also investigated, together with selected behavioural characteristics (see Table 1).

The reliability of the questionnaire was tested on a sample of 102 men and women[19]. The data obtained relating to their characteristics, such as sociodemographic and physical data, lifestyle, dietary habits and most health characteristics, showed very good agreement

Table 1 General structure of the questionnaire

Section 1 – Information about sociodemographic and physical characteristics, lifestyle, and health status
Self-reported: age (years), height (cm), weight (kg)
Questions (closed-ended format) relative to:
Gender (M/F); education (less than high school, high school, degree); income (high, average, low); smoking status (current smoker, former smoker, non-smoker); self-perceived health status (good, fair, poor) and stress level (none, low, high); sports participation (gymnastics, swimming, running, tennis, cycling, etc.) (yes/no); and sports frequency (1–2 times/week, ≥3 times/week)
Questions (open-ended format) relative to:
Occupation (public/private employee, merchant/craftsman, farmer/worker, manager/professional, housewife/pensioner unemployed, student, other occupations); medical conditions (hypertension, hypercholesterolaemia, diabetes, osteoporosis, joint diseases, CVD, anxiety/depression, other conditions); intake of medicines (for hypertension, hypercholesterolaemia, diabetes, osteoporosis, joint diseases, CVD, anxiety/depression, other conditions)
Section 2 – Information regarding dietary habits (FFQ)
Questions (closed-ended format) relative to:
Frequency of consumption (times/d, times/week, times/month, never/occasionally) of eleven food groups: Pasta or rice; Bread, bread-sticks, crackers; Baked products (biscuits, snacks, cakes, pizza, etc.); Meat (fresh, preserved); Fish (fresh, frozen, preserved); Eggs; Pulses (fresh, dried, preserved); Milk or Yoghurt; Cheese; Vegetables (raw, cooked, salad); and Fruit
Alcohol consumption (wine, beer, spirits, etc.) (glasses/d, glasses/week, glasses/month, never/occasionally)
Regular use of wholemeal cereal-based foods (yes/no)
Section 3 – Information regarding the use of food supplements
Questions (closed-ended format) relative to:
Consumption of food supplements during the last 2 years (yes/no)
Consumption of eight categories of food supplements (products containing vitamins and minerals, dietary fibre, fatty acids, antioxidants, probiotics, botanicals and botanical extracts, products targeted to sportsmen or postmenopausal women) (yes/no) with the possibility to enter the name of the product
Section 4 – Information regarding user's behaviour
Questions (closed-ended format) relative to:
Frequency of use (regular, occasional); use in specific physiological conditions (pregnancy/lactation, convalescence, weight-loss diet); purpose of taking food supplements (improvement of health status/well-being, insufficient ingestion with diet, alternative to medicines, improvement of physical performance, delaying ageing); recommendation for use (self-prescription, medical doctor including specialists, pharmacist, friends/relatives, media/press/advertising); self-perceived benefit (great, some, little, none, I don't know); compliance with directions for use (yes/no); awareness of contraindications (yes/no); occurrence of adverse effects (yes/no); and reporting of use and any adverse effects to family doctor (yes/no)

between the two questionnaires (baseline and 1-month re-administration). The reliability of the information concerning the use of food supplements was satisfactory on the whole, and in any case similar to the values found in other studies.

Statistical analysis

The age brackets used for participants were the same as those used to stratify the population before the selection of the sample (18–25 years, 26–45 years, 46–65 years, ≥66 years). BMI was calculated from self-reported height and weight and categorized according to the WHO as underweight (BMI $< 18{\cdot}5\,kg/m^2$), normal weight (BMI = $18{\cdot}5$–$24{\cdot}9\,kg/m^2$), overweight (BMI = $25{\cdot}0$–$29{\cdot}9\,kg/m^2$) or obese (BMI $\geq 30{\cdot}0\,kg/m^2$)[20]. Alcohol consumption was categorized as never/occasionally, ≤2 glasses/d or >2 glasses/d, on the basis of the Italian Guidelines for Healthy Nutrition[21], which indicates a moderate consumption of alcohol (<2–3 glasses/d for men and 1–2 glasses/d for women). Consumption of fruit and vegetables was arbitrarily categorized as <2·5, ≥2·5 to ≤5 and >5 times/d, taking into consideration that many institutions[21–23] suggest an intake of five portions daily for this food category.

Differences between groups for frequency of food supplement use were assessed in the contingency tables using the Pearson χ^2 test. The effect of demographic and physical characteristics, lifestyle, dietary habits, health status and medical conditions on the use of food supplements was also evaluated by univariate and multivariate logistic regression. For any potential predictor variable, effect size was estimated by crude (univariate logistic regression) and adjusted (multivariate logistic regression) odds ratios with 95% confidence intervals. Adjustment was performed according to two different models. In the first model only gender, age group and macro-area were considered as covariates in a fixed model; when evaluating the effect of area, odds ratios were also adjusted for education and income to avoid bias due to the possible differences between areas for these parameters.

In the second model, in addition to gender, age group and macro-area, which were forced into the model, other covariates were selected from among all the potential predictors considered in the analysis using a stepwise backward procedure. The effect of the same variables on the use of different categories of food supplements was also evaluated by multivariate logistic regression. Adjustment was performed considering gender, age group, macro-area and supplement categories as covariates in a fixed model. In this analysis it was not possible to take all potential predictors into account using a stepwise backward procedure, because of the relatively low number of users for the different categories of food supplements. All analyses were performed with the STATA statistical software package release 8·0.

Results

Sample characteristics and prevalence of food supplement use

Of the 10 000 adults selected, 1177 (11·8%) were not traceable (deceased or moved) and 8823 (88·2%) received the questionnaire. Of these, 1723 returned the questionnaire, corresponding to a response rate of 19·5%. Participants' characteristics are shown in Tables 2–4. Forty-nine per cent of participants were users of food supplements; only one participant failed to indicate use or non-use and was excluded from the study. The distribution of participants by town size is similar to that of the original population selected, as is the distribution by gender of the sample as a whole, although not for each individual town (data not shown). However, different response rates were observed by age and geographical area. In particular, more participants than expected were aged 45–65 years (43% observed *v.* 30% expected) and were living in the North of Italy (53% observed *v.* 40% expected). Participants generally had a medium–high level of education, an average income and were mainly either housewives/pensioners or public/private employees. Most participants were of normal weight or overweight, did not smoke, practised sports and declared a moderate consumption of alcohol. With regard to dietary habits, the study showed that some participants had a very low intake (never/occasionally) of some food categories, i.e. milk and yoghurt (17% of participants), eggs (11%), pulses (11%) and fish (9%). However, with the exception of fruit and vegetables, the intakes of different food categories were not included in the statistical analysis as, on the whole, the results seemed to be affected by a degree of under-reporting. With regard to medical conditions, most participants reported no specific disease and considered their health status good or fair, with no or low levels of stress. Among those who reported diseases, high blood pressure, anxiety/depression, high cholesterol and joint diseases were the main declared diseases; less frequently declared were osteoporosis, CVD and diabetes.

Characteristics of food supplement users and non-users

Tables 2–4 show also the characteristics of non-users and users of food supplements. As already noted, the percentage of food supplement users was 49% (Table 2); there was a significantly higher prevalence of use among women than men and in those aged 18–45 years than in older age groups. The use of food supplements was significantly higher in the Northeast and Centre of Italy and in large towns; in participants with a lower BMI value in men but not in women; and in participants with higher levels of education and income. The highest percentage of consumers of food supplements was among students, followed by managers/professionals and public/private employees, while the lowest percentage was among housewives/pensioners and farmers/workers,

Table 2 Demographic and physical characteristics of the sample Italian adult population aged ≥18 years, 2008

	Participants (*n* 1723)		Total (*n* 1722)					Men (*n* 771)					Women (*n* 945)				
			Non-users (*n* 880; 51 %)		Users (*n* 842; 49 %)			Non-users (*n* 457; 59 %)		Users (*n* 313; 41 %)			Non-users (*n* 418; 44 %)		Users (*n* 527; 56 %)		
	n	%	*n*	%	*n*	%	*P*†	*n*	%	*n*	%	*P*†	*n*	%	*n*	%	*P*†
Gender							<0·001										
Male	771	45	457	59	313	41											
Female	945	55	418	44	527	56											
Unknown	7	0·4	–		–												
Age group							<0·001					<0·001					<0·001
18–25 years	36	2	14	39	22	61		9	50	9	50		5	28	13	72	
26–45 years	531	31	207	39	324	61		109	47	125	53		98	33	199	67	
46–65 years	736	43	400	54	336	46		219	63	127	37		180	46	209	54	
≥66 years	411	24	252	61	158	39		119	70	52	30		133	56	106	44	
Unknown	9	0·5	–		–			–		–			–		–		
Area							<0·01					NS					NS
Northwest	429	25	237	55	191	45		118	62	73	38		118	50	118	50	
Northeast	473	28	218	46	255	54		110	56	88	44		108	39	167	61	
Centre	376	22	178	47	198	53		88	57	67	43		89	41	129	59	
South	239	14	132	55	107	45		75	61	47	39		55	48	60	52	
Islands	206	12	115	56	91	44		66	63	38	37		48	48	53	52	
Town size							<0·05					NS					<0·01
Large	1288	75	635	49	652	51		324	59	226	41		307	42	425	58	
Small	435	25	245	56	190	44		133	60	87	40		111	52	102	48	
BMI (kg/m^2)							<0·001					0·001					NS
<18·5	53	3	19	36	34	64		1	25	3	75		18	37	31	63	
18·5–24·9	898	52	411	46	487	54		161	52	149	48		250	43	338	57	
25·0–29·9	578	34	338	59	239	41		232	64	130	36		105	49	109	51	
≥30·0	167	10	98	59	69	41		58	69	26	31		40	48	43	52	
Unknown	27	2	–		–			–		–			–		–		
Education							<0·001					<0·05					<0·001
Less than high school	474	28	296	62	178	8		155	66	80	34		141	59	98	41	
High school	689	40	328	48	360	52		180	56	140	44		147	40	220	60	
Degree	533	31	239	45	294	55		116	57	88	43		123	37	206	63	
Unknown	27	2	–		–			–		–			–		–		
Occupation							<0·001					0·001					<0·001
Housewife/pensioner	653	38	391	60	261	40		177	71	73	29		214	53	188	47	
Public/private employee	615	36	273	44	342	56		151	56	118	44		121	35	224	65	
Manager/professional	177	10	76	43	101	57		51	49	54	51		25	35	47	65	
Merchant/craftsman	81	5	43	53	38	47		29	52	27	48		14	56	11	44	
Farmer/worker	44	3	25	57	19	43		16	53	14	47		9	64	5	36	
Student	33	2	11	33	22	67		7	44	9	56		4	24	13	76	
Unemployed	28	2	14	50	14	50		8	57	6	43		6	43	8	57	
Other occupation	74	4	34	46	40	54		13	54	11	46		21	42	29	58	
Unknown	18	1	–		–			–		–			–		–		
Income							<0·01					NS					0·001
High	75	4	31	41	44	59		17	49	18	51		14	35	26	65	
Average	1158	67	567	49	591	51		305	59	213	41		262	41	378	59	
Low	457	27	263	58	193	42		127	62	77	38		135	54	116	46	
Unknown	33	2	–		–			–		–			–		–		

†*P* value: statistical analysis by the χ^2 test between users and non-users.

Table 3 Lifestyle and dietary habits of the sample Italian adult population aged ≥18 years, 2008

			Total (*n* 1722)					Men (*n* 771)					Women (*n* 945)				
	Participants (*n* 1723)		Non-users (*n* 880; 51 %)		Users (*n* 842; 49 %)			Non-users (*n* 457; 59 %)		Users (*n* 313; 41 %)			Non-users (*n* 418; 44 %)		Users (*n* 527; 56 %)		
	n	%	*n*	%	*n*	%	*P*†	*n*	%	*n*	%	*P*†	*n*	%	*n*	%	*P*†
Sports							<0·001					<0·001					<0·001
No	1036	60	586	57	449	43		295	67	147	33		289	49	302	51	
1–2 times/week	443	26	185	42	258	58		102	50	103	50		82	35	155	65	
≥3 times/week	174	10	73	42	101	58		44	47	50	53		29	37	50	63	
Unknown	70	4	–		–			–		–			–		–		
Smoking status							<0·001					<0·001					NS
Current smoker	308	18	143	46	165	54		78	55	64	45		65	39	101	61	
Former smoker	430	25	253	59	176	41		183	68	86	32		69	43	90	57	
Non-smoker	938	54	456	49	482	51		189	54	160	46		267	45	322	55	
Unknown	47	3	–		–			–		–			–		–		
Alcohol consumption							NS					NS					NS
Never/occasionally	621	36	313	50	309	50		109	58	80	42		203	47	228	53	
≤2 glasses/d	907	53	459	51	449	49		280	60	188	40		177	40	261	60	
>2 glasses/d	100	6	56	56	44	44		48	58	35	42		8	47	9	53	
Unknown	95	6	–		–			–		–			–		–		
Vegetables, fruit							NS					NS					NS
<2·5 times/d	648	38	323	50	325	50		197	55	159	45		125	43	166	57	
≥2·5 and ≤5 times/d	947	55	490	52	457	48		226	62	139	38		263	45	317	55	
>5 times/d	38	2	17	45	21	55		8	80	2	20		9	32	19	68	
Unknown	90	5	–		–			–		–			–		–		
Regular use of wholemeal cereal-based foods							<0·001					<0·01					<0·001
Yes	346	20	119	34	227	66		55	48	59	52		64	28	167	72	
No	1299	75	719	55	580	45		384	61	242	39		332	50	337	50	
Unknown	78	5	–		–			–		–			–		–		

†*P* value: statistical analysis by the χ^2 test between users and non-users.

Table 4 Health status and medical conditions of the sample Italian adult population aged ≥18 years, 2008

			Total (*n* 1722)					Men (*n* 771)					Women (*n* 945)				
	Participants (*n* 1723)		Non-users (*n* 880; 51 %)		Users (*n* 842; 49 %)			Non-users (*n* 457; 59 %)		Users (*n* 313; 41 %)			Non-users (*n* 418; 44 %)		Users (*n* 527; 56 %)		
	n	%	*n*	%	*n*	%	*P*†	*n*	%	*n*	%	*P*†	*n*	%	*n*	%	*P*†
Self-assessed health status							NS					NS					NS
Good	719	42	348	48	371	52		187	56	144	44		160	41	226	59	
Fair	835	49	446	53	388	47		234	61	147	39		210	47	241	53	
Poor	122	7	56	46	66	54		22	56	17	44		34	41	49	59	
Unknown	47	3	–		–			–		–			–		–		
Self-assessed stress level							<0·001					<0·001					<0·001
None	713	41	426	60	287	40		248	66	127	34		175	52	159	48	
Low	867	50	372	43	494	57		175	52	160	48		197	37	334	63	
High	37	2	14	38	23	62		2	22	7	78		12	43	16	57	
Unknown	106	6	–		–			–		–			–		–		
Medical conditions																	
Hypertension							<0·001					<0·01					<0·001
No/No drugs	1297	75	612	47	685	53		313	56	246	44		297	40	438	60	
Yes/No drugs	29	2	17	59	12	41		9	50	9	50		6	67	3	33	
Yes/Drugs	397	23	251	63	145	37		135	70	58	30		115	57	86	43	
Hypercholesterolaemia							NS					NS					<0·05
No/No drugs	1379	80	701	51	678	49		366	60	240	40		332	43	437	57	
Yes/No drugs	165	10	79	48	85	52		48	58	35	42		31	38	50	62	
Yes/Drugs	179	10	100	56	79	44		43	53	38	47		55	58	40	42	
Diabetes							<0·001					NS					<0·001
No/No drugs	1632	95	816	50	815	50		426	59	300	41		386	43	513	57	
Yes/No drugs	10	1	5	50	5	50		3	50	3	50		2	50	2	50	
Yes/Drugs	81	5	59	73	22	27		28	74	10	26		30	71	12	29	
Osteoporosis							NS					NS					NS
No/No drugs	1549	90	795	51	753	49		451	60	307	41		339	43	444	57	
Yes/No drugs	65	4	33	51	32	49		2	67	1	33		31	50	31	50	
Yes/Drugs	109	6	52	48	57	52		4	44	5	57		48	48	52	52	
Joint diseases							NS					NS					NS
No/No drugs	1445	84	741	51	703	49		405	60	269	40		331	43	432	57	
Yes/No drugs	139	8	61	44	78	56		22	46	26	54		39	43	52	57	
Yes/Drugs	139	8	78	56	61	44		30	63	18	37		48	53	43	47	
CVD							NS					NS					NS
No/No drugs	1600	93	813	51	786	49		413	59	286	41		395	44	498	56	
Yes/No drugs	12	1	3	25	9	75		2	50	2	50		1	13	7	87	
Yes/Drugs	111	6	64	58	47	42		42	63	25	37		22	50	22	50	
Anxiety/depression							NS					NS					NS
No/No drugs	1210	70	627	52	583	48		360	60	235	40		265	43	347	57	
Yes/No drugs	212	12	93	44	118	56		31	48	33	52		61	42	85	58	
Yes/Drugs	141	8	75	53	66	47		29	62	18	38		46	49	48	51	
Unknown	160	9	–		–			–		–			–		–		

†*P* value: statistical analysis by the χ^2 test between users and non-users.

Table 5a Use of food supplements in relation to demographic and physical characteristics of the sample Italian adult population aged ≥18 years, 2008 (logistic regression)

	Crude OR	95% CI	Adjusted OR†	95% CI
Gender				
Male	1·00	Ref.	1·00	Ref.
Female	1·84**	1·55, 2·18	1·87**	1·58, 2·22
Age group (years)				
18–25	1·00	Ref.	1·00	Ref.
26–45	1·00	0·41, 2·42	0·93	0·37, 2·35
46–65	0·53	0·22, 1·29	0·51	0·20, 1·26
≥66	0·40*	0·18, 0·88	0·36*	0·15, 0·87
Area				
Northwest	1·00	Ref.	1·00	Ref.
Northeast	1·45**	1·22, 1·73	1·43**	1·19, 1·71
Centre	1·38*	1·06, 1·80	1·25*	1·01, 1·55
South	1·01	0·78, 1·30	1·02	0·83, 1·27
Islands	0·98	0·94, 1·03	1·05	0·83, 1·32
Town size				
Large	1·00	Ref.	1·00	Ref.
Small	0·76*	0·59, 0·96	0·78**	0·66, 0·92
BMI (kg/m^2)				
<18·5	1·51**	1·14, 2·00	1·08	0·80, 1·46
18·5–24·9	1·00	Ref.	1·00	Ref.
25·0–29·9	0·60**	0·46, 0·77	0·79	0·61, 1·02
≥30·0	0·59**	0·45, 0·78	0·79	0·61, 1·02
Education				
Less than high school	1·00	Ref.	1·00	Ref.
High school	1·83**	1·35, 2·47	1·54**	1·12, 2·11
Degree	2·05**	1·54, 2·71	1·53*	1·10, 2·12
Occupation				
Housewife/pensioner	1·00	Ref.	1·00	Ref.
Public/private employee	1·88**	1·56, 2·26	1·43*	1·07, 1·92
Manager/professional	1·99**	1·39, 2·85	1·79**	1·25, 2·58
Merchant/craftsman	1·32	0·99, 1·77	1·32	0·97, 1·78
Farmer/worker	1·14	0·70, 1·84	1·04	0·65, 1·67
Student	3·00**	1·77, 5·09	1·99**	1·43, 2·78
Unemployed	1·50	0·87, 2·58	1·33	0·73, 2·41
Other occupation	1·76	0·98, 3·16	1·34	0·68, 2·62
Income				
High	1·00	Ref.	1·00	Ref.
Medium	0·73*	0·54, 0·99	0·78	0·51, 1·18
Low	0·52**	0·34, 0·78	0·62	0·37, 1·02

Ref., reference category.
*$P<0·05$, **$P<0·01$.
†Adjusted for gender, age group and area; when evaluating the effect of area, OR was also adjusted for education and income.

with differences between the genders. All of these data were confirmed by crude OR, and by adjusted OR, except for BMI and income (Table 5a).

Lifestyle and dietary habits also differed between users and non-users (Table 3). The use of food supplements was significantly more frequent in participants who practised sports and, in men but not in women, in current or non-smokers. No differences were observed in food supplement use with regard to alcohol or fruit and vegetable consumption, while a significant high prevalence was evident in regular consumers of wholemeal cereal-based foods. This general trend was confirmed for all variables by the values of crude OR and by adjusted OR, except for smoking status (Table 5b).

With regard to health status and medical conditions (Table 4), while the perception of health seemed not to affect food supplement use, participants reporting some level of stress used supplements more frequently than unstressed participants ($P<0·001$). Furthermore, participants affected by hypertension or diabetes, on pharmacologic therapy, reported a significant lower use of food supplements than in those not affected by these diseases, with differences for gender. These data were confirmed by logistic regression analysis (Table 5c), which also highlighted a significantly higher consumption of food supplements in participants affected by cardiovascular or joint diseases who were not taking medication. Stepwise logistic regression confirmed all the associations described with the exception of age, occupation and medical conditions such as hypertension, diabetes and CVD. However, the trends for these variables were maintained (data not shown).

Forty-four per cent of users (Fig. 1) used only one category of food supplement and 54% were multiple users; in particular, 29% used two different categories and 25% three or more, with no significant differences between men and women. Vitamin and/or mineral supplements were the most commonly used (Fig. 2), by 61%

Table 5b Use of food supplements in relation to lifestyle and dietary habits of the sample Italian adult population aged ≥18 years, 2008 (logistic regression continued)

	Crude OR	95 % CI	Adjusted OR†	95 % CI
Sports				
No	1·00	Ref.	1·00	Ref.
1–2 times/week	1·82**	1·45, 2·28	1·69**	1·31, 2·18
≥3 times/week	1·81**	1·39, 2·35	1·84**	1·39, 2·44
Smoking status				
Current smoker	1·09	0·83, 1·43	1·12	0·83, 1·51
Former smoker	0·66**	0·50, 0·86	0·84	0·63, 1·13
Non-smoker	1·00	Ref.	1·00	Ref.
Alcohol consumption				
Never/occasionally	1·00	Ref.	1·00	Ref.
≤2 glasses/d	0·99	0·79, 1·24	1·08	0·84, 1·39
> 2 glasses/d	0·79	0·54, 1·16	1·16	0·77, 1·76
Vegetables, fruit				
<2·5 times/d	1·08	0·85, 1·36	1·09	0·82, 1·43
≥2·5 and ≤5 times/d	1·00	Ref.	1·00	Ref.
>5 times/d	1·32	0·75, 2·35	1·29	0·70, 2·38
Wholemeal cereal-based foods regular use				
Yes	2·36**	1·83, 3·06	2·19**	1·59, 3·00
No	1·00	Ref.	1·00	Ref.

Ref., reference category.
*$P < 0·05$, **$P < 0·01$.
†Adjusted for gender, age group and area.

Table 5c Use of food supplements in relation to health status and medical conditions of the sample Italian adult population aged ≥18 years, 2008 (logistic regression continued)

	Crude OR	95 % CI	Adjusted OR†	95 % CI
Self-assessed health status				
Good	1·00	Ref.	1·00	Ref.
Fair	0·82**	0·71, 0·94	1·01	0·89, 1·15
Poor	1·11	0·66, 1·86	1·48	0·87, 2·52
Self-assessed stress level				
None	1·00	Ref.	1·00	Ref.
Low	1·97**	1·70, 2·28	1·77**	1·52, 2·03
High	2·44	0·91, 6·56	1·86	0·63, 5·44
Medical conditions				
Hypertension				
No/No drugs	1·00	Ref.	1·00	Ref.
Yes/No drugs	0·63	0·30, 1·34	0·94	0·39, 2·30
Yes/Drugs	0·52**	0·41, 0·65	0·70**	0·54, 0·91
Hypercholesterolaemia				
No/No drugs	1·00	Ref.	1·00	Ref.
Yes/No drugs	1·11	0·85, 1·46	1·29	0·98, 1·70
Yes/Drugs	0·82	0·66, 1·01	1·25	0·99, 1·58
Diabetes				
No/No drugs	1·00	Ref.	1·00	Ref.
Yes/No drugs	1·00	0·31, 3·27	1·06	0·35, 3·16
Yes/Drugs	0·37**	0·21, 0·66	0·49*	0·26, 0·91
Osteoporosis				
No/No drugs	1·00	Ref.	1·00	Ref.
Yes/No drugs	1·02	0·66, 1·58	1·20	0·78, 1·85
Yes/Drugs	1·16	0·78, 1·71	1·31	0·79, 2·17
Joint diseases				
No/No drugs	1·00	Ref.	1·00	Ref.
Yes/No drugs	1·35*	1·06, 1·72	1·67**	1·23, 2·28
Yes/Drugs	0·82	0·63, 1·08	1·07	0·80, 1·44
CVD				
No/No drugs	1·00	Ref.	1·00	Ref.
Yes/No drugs	3·10*	1·12, 8·63	3·89**	1·62, 9·36
Yes/Drugs	0·76	0·53, 1·08	1·24	0·88, 1·76
Anxiety/depression				
No/No drugs	1·00	Ref.	1·00	Ref.
Yes/No drugs	1·36	0·93, 2·00	1·20	0·80, 1·78
Yes/Drugs	0·95	0·80, 1·12	1·02	0·82, 1·25

Ref., reference category.
*$P < 0·05$, **$P < 0·01$.
†Adjusted for gender, age group and area.

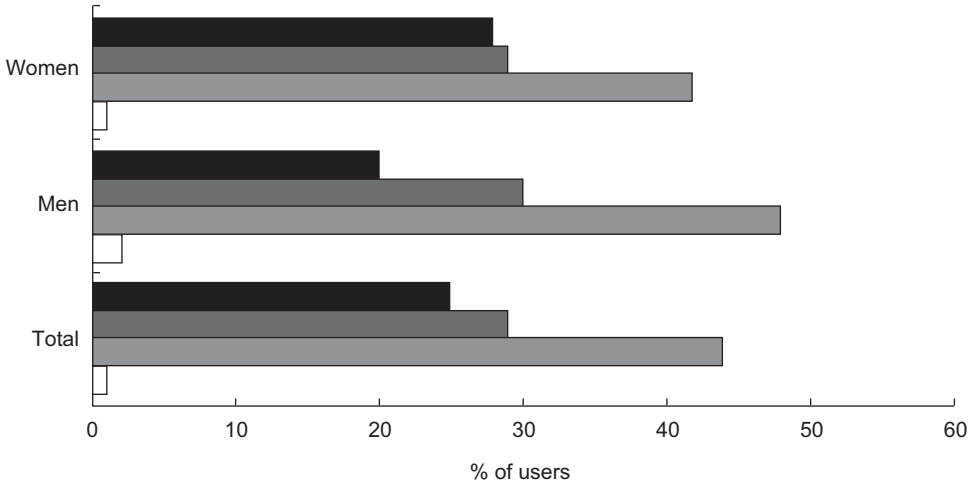

Fig. 1 Number of different categories of food supplements used (■, three or more; ■, two; ■, one; □, not indicated) in a sample Italian adult population aged ≥18 years, 2008. Results are relative to users (n_{users} 527, 313 and 842 for women, men and total population, respectively) and expressed as percentages

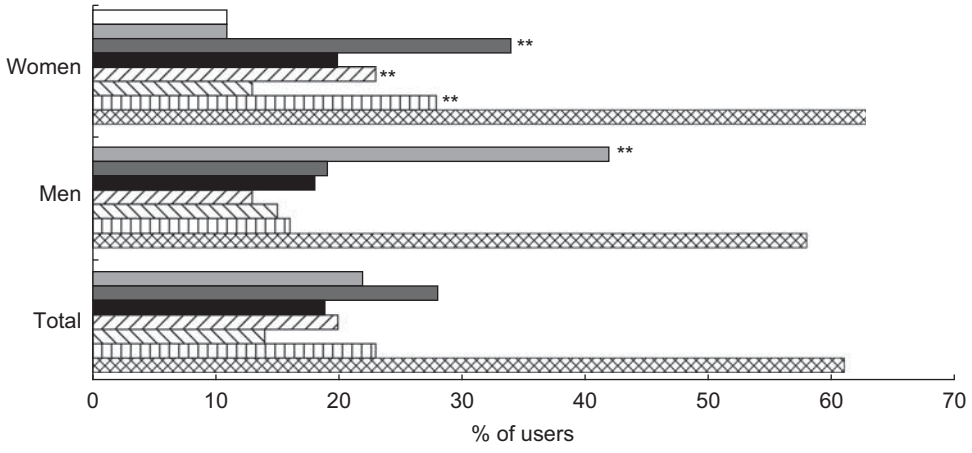

Fig. 2 Use of different categories of food supplements (□, for postmenopausal women; ■, for sports; ■, botanicals; ■, antioxidants; ▨, probiotics; ▨, fatty acids; ▨, dietary fibre; ▨, vitamin and/or mineral) in a sample Italian adult population aged ≥18 years, 2008. Results are relative to users (n_{users} 527, 313 and 842 for women, men and total population, respectively) and expressed as percentages. Percentage of users was significantly different between women and men: $^{**}P < 0{\cdot}01$

of users, followed by supplements with botanicals and botanical extracts (28%), dietary fibre supplements (23%), supplements for sports (22%), probiotics (20%), antioxidants (19%), fatty acids (14%) and supplements for postmenopausal women (11%). Men and women differed significantly in the categories of food supplements used. In particular, women consumed more supplements with botanicals and botanical extracts, dietary fibre and probiotics than did men, while men used supplements for sports more than did women.

Table 6 shows the adjusted OR relative to the effect of the variables associated with the use of food supplements in the whole sample (gender, town size, education, sports practice, regular use of wholemeal cereal-based foods, self-assessed stress level) on the use of the different food supplement categories.

Female gender was significantly associated with the use of vitamin and/or mineral, dietary fibre, probiotic and botanical supplements, but not with use of supplements for sports, for which a negative association existed. A higher consumption of food supplements in large towns was confirmed only for fatty acids and for supplements for sports; instead, for probiotics and botanicals, the association was reversed. A higher education level (high school and/or degree) was confirmed as a significant determinant of usage for most supplements with the exception of probiotics, botanicals and supplements for postmenopausal women. Also sports practice was associated with the use of most supplement categories but showed a significant negative association for vitamins and/or minerals. The regular use of wholemeal cereal-based foods showed a significant positive association

Table 6 Use of different categories of food supplements in relation to selected variables relative to demographic characteristics, lifestyle and dietary habits, and health status of the sample Italian adult population aged ≥18 years, 2008 (logistic regression performed on users)

	Vitamins and/or minerals		Dietary fibre		Fatty acids		Probiotics		Antioxidants		Botanicals or botanical extracts		For sports		For postmenopausal women	
	OR†	95 % CI	OR†	95 % CI	OR†	95 % CI	OR†	95 % CI	OR†	95 % CI	OR†	95 % CI	OR†	95 % CI	OR†	95 % CI
Gender																
Male	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	–	–
Female	1·29*	1·03, 1·61	1·60*	1·09, 2·35	0·67	0·42, 1·04	2·06*	1·11, 3·79	0·91	0·58, 1·43	2·05**	1·23, 3·42	0·18**	0·12, 0·25		
Town size																
Large	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.
Small	0·88	0·68, 1·13	1·09	0·77, 1·56	0·53**	0·36, 0·79	1·36*	1·05, 1·75	0·86	0·68, 1·08	1·22*	1·02, 1·46	0·72*	0·52, 0·99	1·01	0·74, 1·39
Education																
Less than high school	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.
High school	1·26	0·86, 1·83	1·29*	1·00, 1·66	1·88	0·98, 3·62	0·87	0·59, 1·29	1·75*	1·03, 2·98	0·85	0·54, 1·32	1·73*	1·13, 2·66	1·09	0·60, 1·99
Degree	1·67**	1·24, 2·25	1·08	0·60, 1·94	2·18*	1·08, 4·40	0·85	0·55, 1·31	1·87*	1·12, 3·14	0·82	0·53, 1·29	1·41	0·96, 2·06	0·81	0·35, 1·86
Sports																
No	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.
1–2 times/week	0·85	0·71, 1·03	0·99	0·69, 1·41	1·38	0·98, 1·93	1·50*	1·00, 2·25	1·56	0·88, 2·77	1·12	0·66, 1·91	2·46**	1·62, 3·74	1·29	0·60, 2·76
≥3 times/week	0·58**	0·42, 0·78	1·01	0·72, 1·42	2·40**	1·62, 3·57	1·22	0·80, 1·86	2·26**	1·22, 4·19	1·04	0·66, 1·63	6·50**	4·48, 9·43	2·98**	1·19, 7·43
Wholemeal cereal-based foods regular use																
Yes	1·10	0·94, 1·28	1·38	0·89, 2·14	1·33	0·74, 2·37	1·49*	1·07, 2·07	1·01	0·60, 1·71	1·70**	1·23, 2·36	0·96	0·58, 1·59	1·01	0·50, 2·05
No	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.
Self-assessed stress level																
None	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.
Low	1·53**	1·24, 1·88	1·43*	1·08, 1·90	1·65	0·94, 2·92	1·20	0·86, 1·68	0·96	0·67, 1·37	1·32	0·96, 1·83	0·70**	0·59, 0·83	2·38**	1·26, 4·50
High	2·00*	1·11, 3·59	2·40	0·66, 8·78	2·86*	1·03, 7·92	1·21	0·62, 2·34	0·73	0·25, 2·13	1·61	0·81, 3·21	1·22	0·41, 3·63	1·03	0·14, 7·40

Ref., reference category.
*$P < 0·05$, **$P < 0·01$.
†Adjusted for gender, age group, area and use of other supplements.

with probiotics and botanical supplements and a tendency for vitamins/minerals, dietary fibre and fatty acids. Finally, a low level of stress remained a determinant of usage for most food supplements (statistical significance for vitamin and/or mineral, dietary fibre, fatty acids and supplements for postmenopausal women, and a tendency for probiotics and botanicals), with the exception of antioxidants and supplements for sports (for the latter a negative association existed).

Regarding the information collected relative to behaviours, because the reliability of this section of the questionnaire was not totally satisfactory[19], we decided to consider these data with caution and not to show them in the current paper.

Discussion

Other surveys carried out in Europe[4–13] have used different tools to assess food supplement use, such as mailed questionnaires and telephone or face-to-face interviews. Some studies focused specifically on the use of food supplements while others were wider-ranging surveys that also included questions regarding the use of food supplements, often within FFQ or food diaries or other methodologies. In addition, the definitions of supplement users and of food supplements, and the categories of food supplements taken into consideration, were very different. Finally, the statistical evaluation of the data also differed between studies. On account of the different methodologies used, is it not easy to compare the results of the different studies.

The response rate obtained in the current survey was about 20 %, which is lower than that obtained with mailed questionnaires in some European countries (Belgium 37 %, UK 71 %, France 84 %)[5,7,24], but similar to that obtained in USA (21 %) in the Vitamins and Lifestyle (VITAL) Study[25,26].

The prevalence of food supplement use in the population examined was 49 %, and significantly higher in women than in men. The prevalence of use reported in other European countries varies considerably: about 25–44 % in some studies carried out in Germany[4,11], 28 % in Ireland[13], 31–39 % in Sweden[8,12], 35 % in the UK[5,6] and 59 % in Denmark[10]. However, in all cases a higher prevalence was found in women than in men, as in the present study.

The use of food supplements on the whole was significantly higher in the Northeast of Italy and in large towns compared with small towns. After adjustment for gender, age and area, the use was associated with higher education levels (high school or degree) and sports activities. These positive associations were found also in other European countries[4,6,10,12,27] and in the USA[25,26,28].

An inverse association was instead observed for age, which became significant for older participants (≥66 years). A low consumption of food supplements by older individuals was not found in other surveys, in which the use of food supplements either increased with[4,5,8,10,13,25,27,28] or was unrelated to age[12].

No associations were found with smoking status, consumption of alcohol or fruit and vegetable consumption. The absence of any statistical relationship between these variables and the use of dietary supplements was found in some studies but not in others[4–6,8,10].

With respect to health status and medical conditions, after adjustment for gender, age and area, no association was found in the present study for self-assessed health status and the use of food supplements. In some studies carried out in Europe the self-perceived health status of participants was related significantly to the consumption of food supplements in different ways. In a survey conducted in the UK the use of any type of dietary supplements was positively associated with self-rated health[5], while in Sweden and in Denmark the use of food supplements was related to a poor self-perceived health status[8,10].

Furthermore, in the present study, food supplement use was directly associated with a low stress level and the presence of cardiovascular or joint diseases in participants who were not on medication. An inverse association was instead found between the use of food supplements and the presence of hypertension and diabetes in those taking medication for these pathologies. A possible explanation for the associations highlighted could be that individuals taking medication for hypertension and diabetes may not be inclined to add food supplements to their therapeutic schedule, while individuals suffering from cardiovascular or joint diseases who declared not to take medication may consider it useful to consume specific food supplements.

Very few studies have considered stress levels or specific pathologies and food supplement use and the results obtained were heterogeneous. A study conducted in a large cohort of French women[24] showed that users of vitamin/mineral supplements more often perceived their work as stressful. In another study carried out in the UK[5] it was found that people with a history of angina, hypertension, diabetes, heart attack or stroke were less likely to be taking antioxidant, vitamin and/or mineral supplements than those who did not report these conditions. The use of fish-oil supplements was found to be positively associated with arthritis and inversely with angina, diabetes, heart attack or stroke. A study conducted in Switzerland[27] showed that the use of vitamin/mineral supplements was positively related to anxiety/depression or osteoporosis and the use of other food supplements to anxiety/depression or arthritis. A third study on the use of complementary and alternative medicine remedies (vitamins, minerals or biological remedies such as fish oil, ginseng and coenzyme Q_{10}) carried out in Sweden[12] showed that the use of these remedies was nearly identical in people with or without a medical history of hypertension, stroke, myocardial infarction or diabetes.

The majority of the present participants (54 %) used more than one category of food supplements, in agreement with the US population in the National Health and Nutrition Examination Survey (NHANES) carried out in 1999–2000, in which multiple users accounted for 53 % of the population examined[28], and with the National Complementary and Alternative Medicine Use Survey (NCAMUS) 2006, carried out in South Korea, where about 57 % of the participants consumed more than one supplement[29]. However, other studies have shown different situations; for example, in the population examined in the NHANES 2003–2006[30] and in a sample of adults participating in the Danish Investigation on Iodine Intake and Thyroid Diseases 1997–1998[10], most respondents reported taking only one food supplement, but these studies took into consideration a very limited period of consumption (the last month and the time of the survey, respectively). In the present population vitamin and/or mineral supplements were the most used category (61 %) followed by supplements with botanicals and botanical extracts (28 %). These findings are similar to those obtained in the NHANES 2003–2006, which showed that, of the three categories analysed, the prevalence of use of multi-vitamin/multi-mineral supplements was highest, followed by the use of botanical supplements[30]. Other studies have highlighted the prevailing consumption of vitamin/mineral supplements over other categories[4,10,13], but different patterns also exist. For example, the supplement most commonly reported to be used by South Korean adults[29] was ginseng, and in the 1946 British Birth Cohort[6] it was fish-oil supplements.

To evaluate if the determinants of usage differed for the different categories of food supplements, it was decided to calculate, on the whole sample of users, the OR adjusted considering as covariates not only gender, age group and area but also the different categories of supplements, to take into account the effect of the simultaneous use of different supplements. Few studies have been completed to detect the determinants of usage for specific categories of food supplements and data were limited in most cases to vitamin/mineral and herbal supplements. Some of the associations shown in the present study for vitamin and/or mineral supplements were also found in other studies carried out in the USA and Europe, in particular the positive association with female gender and a higher education level[4,9,24,25,27,28,31,32]. The positive association between physical activity and the use of this type of supplement found in some papers[4,24,27,28,32] was reversed in our study. In our study users of supplements with botanicals and botanical extracts were more likely to be women; this finding is in agreement with other studies conducted in different countries[8,26,33–36]. The positive relationship between increased use of this type of supplement and physical activity[8,26,34,36] found in some studies was not found in our population.

There is very little information in the literature regarding the other categories of food supplements considered here. For fatty acid supplements our results are somewhat similar to those of a study performed in Norway on the use of cod-liver oil supplements by women[37]. As in our sample, the use of these supplements increased with higher education levels and physical activity. The positive association between the use of probiotics and female gender found in the present study was also found in a study carried out in South Korea[29]. With regard to antioxidants, some of the associations highlighted here, such as the higher use with higher education levels and physical activity, were also reported in specific clinical trials[38,39]. Finally, to our knowledge, no data regarding the determinants of use of dietary fibre supplements or supplements for sports or postmenopausal women in general populations are present in the literature.

Our study has some limitations. The principal limit is that, due to the relatively low response rate (about 20 %), the study sample is not representative of the general population. Indeed, the adults who agreed to participate in our survey had a higher level of education than the general population (30 % graduates *v.* 11 %)[40] and may be more health-conscious than the non-participants, which would lead to an overestimation of the true prevalence of food supplement use. Finally, a high proportion of participants (43 %) came from a single age group; nevertheless, adjustment for age did not modify the effects described by univariate analyses. For these reasons the results obtained should be regarded as preliminary to further studies introducing strategies to increase the response rate.

Despite these limitations, the present study provided important information for surveillance purposes, given the paucity of data on this topic in Italy. In particular, the study showed that gender, town size, education level, sports practice, regular use of wholemeal cereal-based foods and the presence of low stress levels, although associated with an increased use of food supplements, are not determinants of usage for all categories of supplements. These results support previous observations that the associations between demographic, dietary and lifestyle characteristics, and the use of different categories of food supplements, differ according to products and cannot be accounted for simply by dichotomizing individuals as users or non-users[9,14–17].

To confirm these findings, it would be desirable for other research to be carried out on the same topic; however, these preliminary data are useful for conducting more focused studies and for the national authorities to develop policies regarding the use of food supplements.

Acknowledgements

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sector. None of the authors has any conflicts of interest.

Ethical approval was not required. S.G. and E.S. were involved in study design, data management, and manuscript design and writing. C.F. was involved in statistical analysis and interpretation, and manuscript design and writing. C.B., B.C. and M.M. were involved in data analysis and data interpretation. M.C. was involved in acquiring the data. All co-authors have reviewed and approved the paper.

References

1. European Communities (2002) Directive 2002/46/EC of the European Parliament and of the Council of 10 June 2002 on the approximation of the laws of the Member States relating to food supplements. *Official Journal of the European Communities* 12.7.2002, L183/51–L183/57.
2. European Communities (2008) *Characteristics and Perspectives of the Market for Food Supplements Containing Substances Other Than Vitamins and Minerals. COM (2008) 824 final, SEC (2008) 2976, 5.12.2008*. Brussels: European Communities.
3. European Advisory Services (2007) *The Use of Substances with Nutritional or Physiological Effect Other Than Vitamins and Minerals in Food Supplements. Study undertaken for DG SANCO, European Commission, 28 March 2007*. Brussels: EAS.
4. Reinert A, Rohrmann S, Becker N *et al.* (2007) Lifestyle and diet in people using dietary supplements. A German cohort study. *Eur J Nutr* **46**, 165–173.
5. Harrison RA, Holt D, Pattison DJ *et al.* (2004) Are those in need taking dietary supplements? A survey of 21923 adults. *Br J Nutr* **91**, 617–623.
6. McNaughton SA, Mishra GD, Paul AA *et al.* (2005) Supplement use is associated with health status and health-related behaviours in the 1946 British cohort. *J Nutr* **135**, 1782–1789.
7. Mullie P, Guelinckx I, Clarys P *et al.* (2009) Cultural, socioeconomic and nutritional determinants of functional foods consumption patterns. *Eur J Clin Nutr* **63**, 1290–1296.
8. Messerer M, Johansson SE & Wolk A (2001) Sociodemographic and health behaviour factors among dietary supplement and natural remedy users. *Eur J Clin Nutr* **55**, 1104–1110.
9. de Jong N, Ocké MC, Branderhorst HAC *et al.* (2003) Demographic and lifestyle characteristics of functional foods consumers and dietary supplement users. *Br J Nutr* **89**, 273–281.
10. Knudsen VK, Rasmussen LB, Haraldsdóttir J *et al.* (2002) Use of dietary supplements in Denmark is associated with health and former smoking. *Public Health Nutr* **5**, 463–468.
11. Beitz R, Mensink GBM, Hintzpeter B *et al.* (2004) Do users of dietary supplements differ from nonusers in their food consumption? *Eur J Epidemiol* **19**, 335–341.
12. Nilsson M, Trehn G & Asplund K (2001) Use of complementary and alternative medicine remedies in Sweden. A population-based longitudinal study within the northern Sweden MONICA Project. *J Intern Med* **250**, 225–233.
13. Kiely M, Flynn A, Harrington KE *et al.* (2001) The efficacy and safety of nutritional supplement use in a representative sample of adults in North/South Ireland Food Consumption Survey. *Public Health Nutr* **4**, 1089–1097.
14. Hoggatt KJ, Bernstein L, Reynolds P *et al.* (2002) Correlates of vitamin supplement use in the United States: data from the California Teachers Study cohort. *Cancer Causes Control* **13**, 735–740.
15. Reedy J, Haines PS & Campbell MK (2005) Differences in fruit and vegetable intake among categories of dietary supplement users. *J Am Diet Assoc* **105**, 1749–1756.
16. Robson PJ, Siou GL, Ullman R *et al.* (2008) Sociodemographic, health and lifestyle characteristics reported by discrete groups of adult dietary supplement users in Alberta, Canada: findings from The Tomorrow Project. *Public Health Nutr* **11**, 1238–1247.
17. Kim J, Lee JS, Shin A *et al.* (2010) Sociodemographic and lifestyle factors are associated with the use of dietary supplements in a Korean population. *J Epidemiol* **20**, 197–203.
18. National Institute of Statistics, Italy (2006) Demo-Geodemo: resident population by age, sex and marital status on 1st January, year 2006. http://demo.istat.it/pop2006/index_e.html (accessed July 2012).
19. Giammarioli S, Boniglia C, Carratù B *et al.* (2010) Reliability of a self-administered postal questionnaire on the use of food supplements in an Italian adult population. *Int J Vitam Nutr Res* **80**, 394–407.
20. World Health Organization (2000) *Obesity: Preventing and Managing the Global Epidemic. Report of a WHO Consultation. WHO Technical Report Series* no. 894. Geneva: WHO.
21. Istituto Nazionale di Ricerca per gli Alimenti e la Nutrizione (2003) Linee guida per una sana alimentazione italiana. http://www.inran.it/648/linee_guida.html (accessed July 2012).
22. Food Standards Agency (not dated) Eat well be well – Fruit and veg. http://collections.europarchive.org/tna/20100927130941/http://www.eatwell.gov.uk/healthydiet/nutritionessentials/fruitandveg/ (accessed July 2012).
23. Ministère du Travail, de l'Emploi et de la Santé (not dated) Programme National Nutrition Santé Fruits et legumes: au moin 5 par jour. http://www.mangerbouger.fr/bien-manger/les-9-reperes/fruits-et-legumes-au-moins-5-par-jour.html (accessed July 2012).
24. Touvier M, Kesse E, Volatier JL *et al.* (2006) Dietary and cancer-related behaviours of vitamin/mineral dietary supplement users in a large cohort of French women. *Eur J Nutr* **45**, 205–214.
25. Satia-Abouta J, Kristal AR, Patterson RE *et al.* (2003) Dietary supplement use and medical conditions. The VITAL Study. *Am J Prev Med* **24**, 43–51.
26. Gunther S, Patterson RE, Kristal AR *et al.* (2004) Demographic and health-related correlates of herbal and specialty supplement use. *J Am Diet Assoc* **104**, 27–34.
27. Marques-Vidal P, Pécoud A, Hayoz D *et al.* (2009) Prevalence and characteristics of vitamin or dietary supplement users in Lausanne, Switzerland: the CoLaus study. *Eur J Clin Nutr* **63**, 273–281.
28. Radimer K, Bindewald B, Hughes J *et al.* (2004) Dietary supplement use by US adults: data from the National Health and Nutrition Examination Survey, 1999–2000. *Am J Epidemiol* **160**, 339–349.
29. Ock SM, Hwang SS, Lee JS *et al.* (2010) Dietary supplement use by South Korean adults: data from the National Complementary and Alternative Medicine Use Survey (NCAMUS) in 2006. *Nutr Res Pract* **4**, 69–74.
30. Bailey RL, Gahche JJ, Lentino CV *et al.* (2011) Dietary supplement use in the United States, 2003–2006. *J Nutr* **141**, 261–266.
31. Balluz LS, Kieszak SM, Philen RM *et al.* (2000) Vitamin and mineral supplement use in the United States. Results from the Third National and Nutrition Examination Survey. *Arch Fam Med* **9**, 258–262.
32. Rock CL (2007) Multivitamin–multimineral supplements: who uses them? *Am J Clin Nutr* **85**, issue 1, 277S–279S.
33. Harnack LJ, Rydell SA & Stang J (2001) Prevalence of use of herbal products by adults in the Minneapolis/St Paul, Minn, metropolitan area. *Mayo Clin Proc* **76**, 688–694.
34. Kennedy J (2005) Herb and supplement use in US adult population. *Clin Ther* **27**, 1847–1858.

35. Canter PH & Edzard E (2004) Herbal supplement use by person aged over 50 years in Britain. *Drugs Aging* **21**, 597–605.
36. Harrison RA, Holt D, Pattison DJ *et al.* (2004) Who and how many people are taking herbal supplements? A survey of 21923 adults. *Int J Vitam Nutr Res* **74**, 183–186.
37. Brustadt M, Braaten T & Lund E (2004) Predictors for cod liver oil supplement use – the Norwegian Women and Cancer Study. *Eur J Clin Nutr* **58**, 128–136.
38. Shikany JM, Patterson RE, Agurs-Collins T *et al.* (2003) Antioxidant supplement use in Women's Health Initiative participants. *Prev Med* **36**, 379–387.
39. Neuhouser ML, Kristal AR, Patterson RE *et al.* (2001) Dietary supplement use in Prostate Cancer Prevention Trial: implications for prevention trials. *Nutr Cancer* **39**, 12–18.
40. National Institute of Statistics, Italy (2008) Population aged 15 years and over by education level, sex and region, year 2008. http://www.istat.it/it/archivio/17290 (accessed July 2012).