Differences in dietary intakes, food sources and determinants of total flavonoids between Mediterranean and non-Mediterranean countries participating in the European Prospective Investigation into Cancer and Nutrition (EPIC) study

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23Hellenic Health Foundation, Athens, Greece

Abbreviations: 24-HDR, 24 h dietary recall; EPIC, European Prospective Investigation into Cancer and Nutrition; FCDB, food composition database; MED, Mediterranean; PA, proanthocyanidins.

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A Mediterranean (MED) diet is the traditional dietary pattern observed in countries bordering the Mediterranean Sea. It is characterised by a high consumption of fruits, vegetables, unrefined cereals, legumes, nuts and seeds, olive oil, a moderate wine consumption and lower intake of animal products. The MED diet was proposed as a healthy dietary pattern characterised by a high consumption of fruits, vegetables, and Mediterranean crops (35–74 years) and recruited between 1992 and 2000, in twenty-six study centres were estimated using standardised 24 h dietary recall software (EPIC-Sof). An ad hoc food composition database on flavonoids was compiled using analytical data from the United States Department of Agriculture and Phenol-Explorer databases. Moreover, it was expanded to include using recipes, estimates of missing values and flavonoid retention factors. No significant differences in total flavonoid mean intake between non-MED countries (373.7 mg/d) and MED countries (370.2 mg/d) were observed. In the non-MED region, the main contributors were proanthocyanidins (48.2%) and flavan-3-ol monomers (24.9%) and the principal food sources were tea (25.7%) and fruits (32.8%). In the MED region, proanthocyanidins (59.0%) were by far the most abundant contributor and fruits (55.1%), wines (16.7%) and tea (6.8%) were the main food sources. The present study shows similar results for total dietary flavonoid intakes, but significant differences in flavonoid class intakes, food sources and some characteristics between MED and non-MED countries. These differences should be considered in studies about the relationships between dietary intake and chronic diseases.

Abstract

A greater adherence to the traditional Mediterranean (MED) diet is associated with a reduced risk of developing chronic diseases. This dietary pattern is based on higher consumption of plant products that are rich in flavonoids. We compared the total flavonoid dietary intakes, their food sources and various lifestyle factors between MED and non-MED countries participating in the EPIC study. Flavonoid intakes and their food sources for 35,628 subjects, aged 35–74 years and recruited between 1992 and 2000, in twenty-six study centres were estimated using standardised 24 h dietary recall software (EPIC-Sof). An ad hoc food composition database on flavonoids was compiled using analytical data from the United States Department of Agriculture and Phenol-Explorer databases. Moreover, it was expanded to include using recipes, estimates of missing values and flavonoid retention factors. No significant differences in total flavonoid mean intake between non-MED countries (373.7 mg/d) and MED countries (370.2 mg/d) were observed. In the non-MED region, the main contributors were proanthocyanidins (48.2%) and flavan-3-ol monomers (24.9%) and the principal food sources were tea (25.7%) and fruits (32.8%). In the MED region, proanthocyanidins (59.0%) were by far the most abundant contributor and fruits (55.1%), wines (16.7%) and tea (6.8%) were the main food sources. The present study shows similar results for total dietary flavonoid intakes, but significant differences in flavonoid class intakes, food sources and some characteristics between MED and non-MED countries. These differences should be considered in studies about the relationships between dietary intake and chronic diseases.

Key words: Flavonoids: Intake: Sources: Phenolics: European Prospective Investigation into Cancer and Nutrition
Table 1. Estimated flavonoid intake in adults in several countries

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Country</th>
<th>Population</th>
<th>Dietary assessment</th>
<th>FCDB</th>
<th>Flavonoid without PA intake (mg/d)</th>
<th>PA intake (mg/d)</th>
<th>Total flavonoid intake (mg/d)</th>
<th>Major class contributor</th>
<th>Main food sources</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUVIMAX</td>
<td>1994</td>
<td>France</td>
<td>4942</td>
<td>Dietary history</td>
<td>Phenol explorer*</td>
<td>201</td>
<td>227</td>
<td>428</td>
<td>PA (53 %)</td>
<td>Fruits, wine, tea</td>
<td>(20)</td>
</tr>
<tr>
<td>Stomach cancer case–control</td>
<td>1997–2007</td>
<td>Italy</td>
<td>777</td>
<td>FFQ</td>
<td>USDA†</td>
<td>127‡</td>
<td>291</td>
<td>417</td>
<td>PA (70 %)</td>
<td>Fruits, wine, tea</td>
<td>(17)</td>
</tr>
<tr>
<td>EPIC</td>
<td>1992–2000</td>
<td>Spain</td>
<td>40,683</td>
<td>Dietary history</td>
<td>USDA§</td>
<td>124‡</td>
<td>189</td>
<td>313</td>
<td>PA (60 %) Flavan-3-ols (64 %)</td>
<td>Fruits, wine, tea</td>
<td>(19)</td>
</tr>
<tr>
<td>EPIC</td>
<td>1992–2000</td>
<td>USA</td>
<td>8809</td>
<td>24-HDR</td>
<td>USDA†</td>
<td>190‡</td>
<td>95</td>
<td>285</td>
<td>Flavan-3-ols (93 %)</td>
<td>Fruits, wine, tea</td>
<td>(14, 15)</td>
</tr>
<tr>
<td>FINDIET</td>
<td>2002</td>
<td>Finland</td>
<td>2007</td>
<td>48-HDR</td>
<td>Finnish FCDB</td>
<td>93</td>
<td></td>
<td></td>
<td>116</td>
<td>209</td>
<td>PA (50 %)</td>
</tr>
<tr>
<td>EPIC</td>
<td>1994–1999</td>
<td>Greece</td>
<td>28,572</td>
<td>FFQ</td>
<td>USDA§</td>
<td>86‡</td>
<td>75</td>
<td>161</td>
<td>PA (47 %) Flavan-3-ols (93 %)</td>
<td>Fruits, wine, tea</td>
<td>(18)</td>
</tr>
<tr>
<td>National Nutrition Survey</td>
<td>1995</td>
<td>Australia</td>
<td>17,326</td>
<td>24-HDR</td>
<td>USDA†</td>
<td>454‡</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(21)</td>
</tr>
<tr>
<td>Dutch National Food Consumption Survey</td>
<td>1985</td>
<td>The Netherlands</td>
<td>10,312</td>
<td>Dietary history</td>
<td>USDA†</td>
<td>211‡</td>
<td></td>
<td></td>
<td></td>
<td>Flavan-3-ols (69 %)</td>
<td>(23, 24)</td>
</tr>
<tr>
<td>Danish Household Consumption Survey</td>
<td>1987</td>
<td>Denmark</td>
<td>17,326</td>
<td>Dietary history</td>
<td>USDA†</td>
<td>175‡</td>
<td></td>
<td></td>
<td></td>
<td>Flavan-3-ols (85 %)</td>
<td>(22)</td>
</tr>
</tbody>
</table>

FCDB, food composition database; PA, proanthocyanidins; SUVIMAX, Supplémentation en Vitamines et Minéraux Anti-oXydants Study; USDA, United States Department of Agriculture; EPIC, European Prospective Investigation into Cancer and Nutrition; NHANES, National Health and Nutrition Examination Survey; 24-HDR, 24 h dietary recall; FINDIET, National Finnish Diet Study; 48-HDR, 48 h dietary recall.

* Database with dihydroflavonols which were included in total flavonoid intake presented in this table.
† USDA database on flavonoids, version 1, March 2003.
‡ Thearubigins were included in total flavonoid intake presented in this table.
§ Theaflavins and thearubigins were not included in total flavonoid intake presented in this table.
¶ Calculated taking into account flavonoid intake without PA, because PA intake was not available at the time the study was done.
** Recalculated using USDA databases by Johannot & Somerset (21).
Prospective Investigation into Cancer and Nutrition (EPIC) study. Furthermore, the present study also aimed to assess the main flavonoid food sources and lifestyle characteristics that could partly explain the flavonoid intake variability among these countries.

Materials and methods

Study population

The EPIC study is an ongoing prospective cohort study conducted in twenty-three centres throughout ten European countries to investigate the role of nutrition, lifestyle, biomarkers and genetic factors in the aetiology of cancer and other chronic diseases. A total of 521,448 subjects (29.4% men), aged 21–83 years, were enrolled between 1992 and 2000. Most of the participants were recruited from the general population within defined geographical areas, with some exceptions: women who were members of a health insurance programme for state school employees (France), women attending breast cancer screening (Utrecht, the Netherlands and Florence, Italy), blood donors (some centres in Italy and Spain) and vegetarians (the ‘health conscious’ cohort in Oxford, UK). For the purpose of dietary analyses, the twenty-three administrative EPIC centres were redefined into twenty-seven geographical areas. A total of nineteen of the twenty-seven redefined EPIC centres had both male and female participants, and eight recruited only women (France; Norway; Utrecht, The Netherlands, and Naples, Italy).

Dietary data used in the present paper were obtained from the EPIC calibration study, in which a 24 h dietary recall (24-HDR) was administered to a stratified random sample of approximately 8% (36,994 subjects) of the entire EPIC cohort. A total of 35,628 subjects with 24-HDR data from twenty-six centres were included in the present analysis, after exclusion of sixteen subjects due to missing baseline FFQ data, 941 subjects aged less than 35 years or over 74 years (because these age groups had low representation) and all participants from the health conscious group (409 subjects), because vegetarians and vegans consume a very different diet from the rest of the cohort. The present study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects were approved by ethical review boards from the rest of the cohort. The present study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects were approved by ethical review boards from the International Agency for Research on Cancer (IARC) and all local participating centres approved the study. Written informed consent was obtained from all subjects.

Dietary and lifestyle information

Dietary information was obtained through a single standardised 24-HDR interview using computerised software (EPIC-Soft®; International Agency for Research on Cancer) which was administered face-to-face in all centres, except in Norway, where it was done by telephonic interview. In the EPIC study, about 2000 aggregated food items were reported per country in the 24-HDR, of which approximately forty food items were not present in our food composition database (FCDB). Most of these food items, except coffee substitutes and cola drinks, do not contain flavonoids in their composition (such as water, sugar, margarine, caramel, white chocolate, tonic soft drink, chewing gum, artificial sweetener, salt and gelatine) or they are infrequently consumed in the EPIC population (such as bamboo sprouts, carambola, pumpkin flower, orgeat, rose hips, physalis and vanilla). Data on other lifestyle factors, including education, anthropometry, physical activity (combining both occupation, household and leisure time activities) and smoking history, were collected at baseline through standardised questionnaires and have been described elsewhere. Data on age, as well as on body weight and height, were mostly self-reported by the participants during the 24-HDR interview. The mean time interval between these baseline measures and the 24-HDR interview varied by country, from 1 d to 3 years later.

Flavonoid Food Composition Database

Our FCDB gathered composition data on six flavonoid classes: anthocyanidins (cyanidin, delphinidin, malvidin, pelargonidin, peonidin and petunidin), flavanols (flavan-3-ol monomers (catechin, epigallocatechin, epicatechin, epicatechin-3-gallate, epigallocatechin-3-gallate, gallo catechin and catechin-3-gallate), PA (dimers, trimers, 4–6-mers, 7–10-mers and >10-mers) and theaflavins (theaflavin, theaflavin-3,3’-digallate, theaflavin-3’-gallate and theaflavin-3-gallate)), flavonols (iso rhamnetin, kaempferol, myricetin and quercetin), flavones (apigenin and luteolin), flavanones (eriodictyol, hesperetin and naringenin) and isoflavones (daidzein, genistein, glycitein, biochanin A, formononetin and equol). Thearubigins were not included in the present study because they were obtained by a non-specific spectrophotometric method. Flavonoid data were mainly obtained from the United States Department of Agriculture FCDB on flavonoids (version 2.1 released in 2007, although more recently a new version has been developed in 2011), isoflavones (updated in 2008) and PA (released in 2004), and the Phenol-Explorer FCDB (developed in 2009) and the UK Food Standards Agency FCDB on isoflavones (released in 2010). The United States Department of Agriculture and Phenol-Explorer FCDB contain flavonoid data from a systematic and comprehensive collection of worldwide analytical data. Furthermore, our flavonoid FCDB was expanded by using retention factors, calculating flavonoid content of recipes, estimating missing values based on similar foods (by botanical family and plant part), obtaining consumption data for food group items and employing botanical data for logical zeros. The retention factors applied to all flavonoid classes, except isoflavones, were 0–70, 0–55 and 0–25 after frying, cooking in a microwave oven and boiling, respectively. These retention factors were not applied to isoflavones, because their cooking losses are usually minimal. The final FCDB on flavonoids contained 1877 food items and 10% of these food items had missing values.
Statistical analyses

Dietary flavonoid values were calculated using generalised linear models and presented as means with standard errors stratified by sex and the redefined centres, which were ordered geographically from south to north. These models were adjusted for age (continuous variable) and weighted by season and weekday of the 24-HDR to control for different distributions of participants across seasons and weekdays of the recall. The contribution of each individual compound and class of flavonoids to the total intake was calculated as a percentage according to the two European regions (MED countries: all centres in Greece, Spain, Italy and the south of France; non-MED countries: all centres in the north-east and north-west of France, Germany, the Netherlands, UK general population, Denmark, Sweden and Norway). The contribution of each food group to overall flavonoid intake by European region was also computed as a percentage.

Differences in flavonoid intakes stratified by European region were also compared using general linear models according to the categories of sex, age (35–44, 45–54, 55–64 or 65–74 years), BMI (<25, 25 to <30 or ≥30 kg/m²), educational level (none, primary completed, technical/professional, secondary school or university degree), smoking status (never smoker, present smoker or former smoker) and level of physical activity (inactive, moderately inactive, moderately active or active). All these models were adjusted for sex (categorical), age (continuous), centre (categorical), BMI (continuous) and energy intake (continuous) and weighted by season and weekday. P values ≤0.05 (two-tailed) were considered significant. All analyses were conducted using the SPSS Statistics software (version 19.0; SPSS Inc.).

Results

For both sexes, consumers with the highest total flavonoid intake were from the UK general population (in men 548.8 mg/d and in women 501.7 mg/d). Meanwhile, consumers with the lowest total flavonoid intake were in Greece (in men 250.7 mg/d and in women 203.6 mg/d; Fig. 1). There was no statistically significant difference in flavonoid intake when adjusted for sex, age, centre, BMI and energy consumption and weighted by season and weekday of 24-HDR between the MED region (370.2 mg/d) and the non-MED region (373.7 mg/d; $p=0.349$; Table 2). Men had a statistically higher intake of total flavonoids than women in MED countries, while the inverse was found in non-MED countries. Younger people had significantly lower flavonoid consumption than older people in MED and non-MED regions. An inverse trend between BMI and total flavonoid intake was observed in both regions. According to educational level, participants with technical/professional studies and university graduates had the highest consumption of flavonoids in MED and non-MED countries, respectively. Never and former smokers had the highest flavonoid intakes in both MED and non-MED countries. Physically active participants had the highest intakes, particularly in the MED region.

Table 3 shows the flavonoid class contributors to the total flavonoid intake. Flavanol class was the main contributor in both regions, ranging from 72.5 to 75.0%. More specifically, in MED countries, PA contributed 59.0% and flavan-3-ol monomers only 13.1%, whereas in non-MED region, PA and flavan-3-ol monomers contributed 48.2 and 24.9% respectively. Flavonols, flavanones and anthocyanidins were intermediate contributors in all regions (7.3–10.1%). Finally, the contributions of flavones and isoflavones were minor (<1.5%).

The main food sources of dietary flavonoid intake according to European region are presented in Table 4. In non-MED countries, tea and fruits were the main food items contributing 25.7 and 32.8% of total flavonoid intake, respectively. Other moderate contributors consisted of wines, juices, cereals, sweets and chocolate products. However, in MED countries, fruits (55.1%, mainly apples and pears), wines (16.7%), tea (6.8%) and vegetables (4.5%) were the most important food sources.

![Fig. 1. Adjusted daily flavonoid intake (mg/d), stratified by sex and centre ordered from south to north, adjusted for age and weighted by season and weekday of dietary recall. GRE, Greece; SPA, Spain; ITA, Italy, FRA, France, GER, Germany; NED, The Netherlands; DEN, Denmark; SWE, Sweden; NOR, Norway; ■ men; ◇ women. Values are means, with standard errors represented by vertical bars.](https://www.cambridge.org/core/terms). IP address: 54.70.40.11, on 06 Feb 2019 at 08:40:01 subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. DOI: 10.1017/S0007114512003273.
countries consuming more apples and pears and red wine than southern areas.  
In non-MED countries, there was also a broad range of flavonoid intakes from 275.7 mg/d for women from Malmö (Sweden) to 548.8 mg/d for men of the UK general population. In this region, the main food sources were clearly tea (25.7%) and fruits (32.8%) and the major flavonoid class contributors were PA and flavan-3-ol monomers. Countries where tea is widely consumed, such as the UK, The Netherlands, Denmark or Australia will generally have high flavonoid intakes from 275.7 mg/d for women from Malmö (Sweden) to 548.8 mg/d for men of the UK general population. In this region, the main food sources were clearly tea (25.7%) and fruits (32.8%) and the major flavonoid class contributors were PA and flavan-3-ol monomers. Countries where tea is widely consumed, such as the UK, The Netherlands, Denmark or Australia will generally have high flavonoid intakes from 275.7 mg/d for women from Malmö (Sweden) to 548.8 mg/d for men of the UK general population. In this region, the main food sources were clearly tea (25.7%) and fruits (32.8%) and the major flavonoid class contributors were PA and flavan-3-ol monomers. Countries where tea is widely consumed, such as the UK, The Netherlands, Denmark or Australia will generally have high flavonoid intakes from 275.7 mg/d for women from Malmö (Sweden) to 548.8 mg/d for men of the UK general population. In this region, the main food sources were clearly tea (25.7%) and fruits (32.8%) and the major flavonoid class contributors were PA and flavan-3-ol monomers. Countries where tea is widely consumed, such as the UK, The Netherlands, Denmark or Australia will generally have high flavonoid intakes from 275.7 mg/d for women from Malmö (Sweden) to 548.8 mg/d for men of the UK general population. In this region, the main food sources were clearly tea (25.7%) and fruits (32.8%) and the major flavonoid class contributors were PA and flavan-3-ol monomers. Countries where tea is widely consumed, such as the UK, The Netherlands, Denmark or Australia will generally have high flavonoid intakes from 275.7 mg/d for women from Malmö (Sweden) to 548.8 mg/d for men of the UK general population. In this region, the main food sources were clearly tea (25.7%) and fruits (32.8%) and the major flavonoid class contributors were PA and flavan-3-ol monomers. Countries where tea is widely consumed, such as the UK, The Netherlands, Denmark or Australia will generally have high flavonoid intakes from 275.7 mg/d for women from Malmö (Sweden) to 548.8 mg/d for men of the UK general population. In this region, the main food sources were clearly tea (25.7%) and fruits (32.8%) and the major flavonoid class contributors were PA and flavan-3-ol monomers. Countries where tea is widely consumed, such as the UK, The Netherlands, Denmark or Australia will generally have high flavonoid intakes from 275.7 mg/d for women from Malmö (Sweden) to 548.8 mg/d for men of the UK general population. In this region, the main food sources were clearly tea (25.7%) and fruits (32.8%) and the major flavonoid class contributors were PA and flavan-3-ol monomers. Countries where tea is widely consumed, such as the UK, The Netherlands, Denmark or Australia will generally have high flavonoid intakes from 275.7 mg/d for women from Malmö (Sweden) to 548.8 mg/d for men of the UK general population. In this region, the main food sources were clearly tea (25.7%) and fruits (32.8%) and the major flavonoid class contributors were PA and flavan-3-ol monomers. Countries where tea is widely consumed, such as the UK, The Netherlands, Denmark or Australia will generally have high flavono...
intake, as a result of the sum of flavan-3-ol monomers and flavanol-derived compounds (theaflavins and thearubigins), the latter being the highest contributing class\(^{21-24}\). However, in the present study, thearubigins were not included because they were obtained by an unsuitable method\(^7\). Excluding thearubigins from the analysis, PA became the major flavonoid contributor in the non-MED region, especially in countries where tea consumption is less prevalent, for instance, in our Scandinavian centres (data not shown) or in a recent Finnish study\(^{16}\).

Differences between MED and non-MED countries were also explained by some socio-demographic, anthropometric and lifestyle factors. With respect to sex, men had a higher flavonoid intake than women in MED countries as men tend to drink more wine, particularly red wine\(^{19}\). However, in non-MED countries, the opposite was found, as women tended to consume more tea than men\(^{44}\). Flavonoid intake was also shown to increase with age in both these regions\(^{19,44}\). Again, the observed differences were largely due to variations in wine and tea consumption. A US study\(^{14}\) showed that flavonoid intake increased up to the age group of 51–70 years, but in the age group >70 years, the consumption decreased significantly. In the present study, this reduction was also clearly detected in the oldest age group (65–74 years). Also, in the present study, participants living in the non-MED region and having a BMI of less than 25 kg/m\(^2\) had a significantly higher flavonoid consumption than those in any other BMI groups. In the MED countries, no statistical difference was observed between normal and overweight participants and flavonoid intake. However, in a previous analysis from the EPIC-Spain cohort, overweight people had the highest flavonoid intake; the difference was small but statistically significant\(^{19}\). In the non-MED region, less-educated adults had the lowest flavonoid intake, while people with a university degree had the highest; thus, flavonoid intake seems to increase with higher educational level. In contrast, in an US study, flavonoid intake was higher among those with a higher poverty income ratio\(^{14}\). People with a higher education and/or income are usually more conscious of good nutrition and health, so they may take more care of themselves and consume more healthy foods such as fresh fruit and vegetables\(^{45,46}\). However, in MED countries, the highest flavonoid intake was observed in the subjects of technical/professional education, who also tended to have the highest wine intakes\(^{47}\). Never and former smokers had a higher flavonoid intake than present smokers in both MED and non-MED countries.

### Table 4. Percentage contributions of food groups and some main foods to the intake of flavonoids by European region

<table>
<thead>
<tr>
<th>Food items</th>
<th>MED countries (%)</th>
<th>Non-MED countries (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potatoes and other tubers</td>
<td>0-1</td>
<td>0-2</td>
</tr>
<tr>
<td>Vegetables</td>
<td>4-5</td>
<td>2-1</td>
</tr>
<tr>
<td>Leafy vegetables</td>
<td>1-8</td>
<td>0-6</td>
</tr>
<tr>
<td>Fruiting vegetables</td>
<td>0-8</td>
<td>0-3</td>
</tr>
<tr>
<td>Root vegetables</td>
<td>0-1</td>
<td>0-2</td>
</tr>
<tr>
<td>Cabbages</td>
<td>0-1</td>
<td>0-2</td>
</tr>
<tr>
<td>Grain and pod vegetables</td>
<td>0-4</td>
<td>0-1</td>
</tr>
<tr>
<td>Onion, garlic</td>
<td>0-9</td>
<td>0-5</td>
</tr>
<tr>
<td>Other vegetables</td>
<td>0-3</td>
<td>0-2</td>
</tr>
<tr>
<td>Legumes</td>
<td>1-4</td>
<td>0-5</td>
</tr>
<tr>
<td>Fruits</td>
<td>55-1</td>
<td>32-8</td>
</tr>
<tr>
<td>Citrus fruit</td>
<td>7-0</td>
<td>3-7</td>
</tr>
<tr>
<td>Apples and pears</td>
<td>25-9</td>
<td>17-2</td>
</tr>
<tr>
<td>Grapes</td>
<td>5-6</td>
<td>2-6</td>
</tr>
<tr>
<td>Stone fruits</td>
<td>11-7</td>
<td>4-0</td>
</tr>
<tr>
<td>Berries</td>
<td>2-9</td>
<td>3-5</td>
</tr>
<tr>
<td>Kiwi</td>
<td>0-2</td>
<td>0-1</td>
</tr>
<tr>
<td>Other fruits</td>
<td>1-9</td>
<td>1-7</td>
</tr>
<tr>
<td>Nuts and seeds</td>
<td>0-7</td>
<td>0-4</td>
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<tr>
<td>Dairy products</td>
<td>0-5</td>
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</tr>
<tr>
<td>Cereals, cakes, biscuits and sweets</td>
<td>3-7</td>
<td>6-1</td>
</tr>
<tr>
<td>Chocolate products</td>
<td>3-6</td>
<td>4-4</td>
</tr>
<tr>
<td>Non-alcoholic beverages</td>
<td>9-4</td>
<td>35-3</td>
</tr>
<tr>
<td>Tea</td>
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<td>25-7</td>
</tr>
<tr>
<td>Fruit and vegetable juices</td>
<td>2-4</td>
<td>7-1</td>
</tr>
<tr>
<td>Other non-alcoholic beverages</td>
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<td>2-5</td>
</tr>
<tr>
<td>Alcoholic beverages</td>
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<td>13-0</td>
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<tr>
<td>Wines</td>
<td>16-7</td>
<td>9-8</td>
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<tr>
<td>Beer and cider</td>
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<td>2-6</td>
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<tr>
<td>Other alcoholic beverages</td>
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<td>0-5</td>
</tr>
<tr>
<td>Condiments and sauces</td>
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<td>0-6</td>
</tr>
<tr>
<td>Soups, bouillons</td>
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<tr>
<td>Soya products</td>
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<td>0-1</td>
</tr>
<tr>
<td>Meat, fish and eggs</td>
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<td>0-0</td>
</tr>
<tr>
<td>Fat and oils</td>
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</tr>
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* Values are percentages derived from models adjusted for age and sex and weighted by season and weekday of recall.
in the future as a first step in dietary flavonoid assessment and their potential role in health and disease.

Acknowledgements

The authors declare no conflict of interest. The present work was carried out with the financial support of the European Commission: Public Health and Consumer Protection Directorate-General 1993 to 2004; Research Directorate-General 2005; Ligue contre le Cancer, Institut Gustave Roussy, Mutuelle Générale de l’Education Nationale, Institut National de la Santé et de la Recherche Médicale (INSERM) (France); German Cancer Aid; German Cancer Research Center; German Federal Ministry of Education and Research; Danish Cancer Society; the Spanish Ministry of Health (ISCIII RETICC RD06/0020); Spanish Regional Governments of Andalusia, Asturias, Basque Country, Murcia (No. 6236) and Navarra and the Catalan Institute of Oncology; 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; the Hellenic Health Foundation and the Stavros Niarchos Foundation; Italian Association for Research on Cancer; Compagnia San Paolo, Italy; Dutch Ministry of Public Health, Welfare and Sports; Dutch Ministry of Health; Dutch Prevention Funds; LK Research Funds; Dutch ZON (Zorg Onderzoek Nederland); World Cancer Research Fund (WCRF); Statistics Netherlands (The Netherlands); Swedish Cancer Society; Swedish Scientific Council; Regional Government of Skane, Sweden; Nordforsk – Center of Excellence Programme; some authors are partners of Environmental Cancer Risk, Nutrition and Individual Susceptibility (ECNIS), a network of excellence of the 6th Framework Programme of the European Commission. R. Z.-R. is thankful for a post-doctoral ‘Sara Borrell’ programme (CD09/00133) from the MEC and Instituto de Salud Carlos III. The author contributions are as follows: R. Z.-R. and C. A. G. designed the research; R. Z.-R. and V. K. conducted the research; R. Z.-R. and C. A. G. wrote the manuscript. All authors read, critically reviewed and approved the final manuscript.

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