# WoRld map of cOnsUmption of fruit and vegetables and Nutrient Deficits project


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## Background

The World Health Organization (WHO) Global Status Report on non-communicable diseases (NCDs) 2010 [1] reported that 63% of the 57 million global deaths in 2008 were due to NCDs and are preventable through the reduction of the four main behavioral risk factors: tobacco use, physical inactivity, harmful use of alcohol, and unhealthy diet [1]. In 2017, 11 million deaths and 255 million disability-adjusted life years (DALYs) were attributable to dietary risk factors, with low intake of fruits being the third highest dietary risk factor and accounting for 2 million deaths and 65 million DALYs [2]. The WHO/FAO have reported convincing associations between fruit and vegetable (F&V) consumption and reduced risk of CVD, and also protective association for coronary heart disease (CHD) and stroke. F&V intake is further understood to reduce the risk of some cancers [3].

## Aims

The ROUND project aims to develop a dynamic world map showing adult F&V consumption in different countries and regions, and to determine the percentage contribution of different nutrients from fruits, vegetables and legumes, compared to recommended daily nutrient intakes for both adults and elderly populations.

## Methods

**Availability** data (mean g/capita/day) for 159 fruit, vegetable, legume, and starchy roots/tuber products were extracted from the International Estimated Daily Intake (IEDI) database [4], which codex coded individual commodities from the WHO Global Environment Monitoring System / Food Contamination Monitoring and Assessment Programme (GEMS/Food) [5] 17 cluster diets food availability data.

**European Food Safety Authority (EFSA) chronic consumption data** (all subjects, 18-64 yrs and 65-74 yrs) [6] from 29 studies across 19 countries were extracted for the following level 1 EFSA groups: fruit and fruit products, vegetables and vegetable products; fruit and vegetable juices and nectars; starchy roots or tubers. Legumes were extracted at level 3.

Each individual IEDI/GEMS and EFSA product was matched with the nearest similar product in the **Public Health England McCance and Widdowson composition of foods database** [10], or when not available, the **U.S. food composition online database** [11] was used.

Estimated percentage contributions of daily availability or consumption of nutrients to meeting **U.S. Recommended Dietary Allowances** (RDAs) or Adequate Intakes (AIs) (as males aged 19-50 years for adults, or males >70 years for elderly) [12] were calculated for the 19 nutrients and fiber.

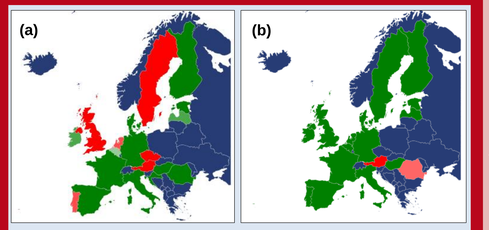


***Figure 1*** *Maps showing* ***a)*** *Europe adult consumption,* ***b)*** *Elderly consumption. Where green indicates studies resulting in a mean consumption of fruit, vegetables, juice, and legumes >400 g/person/d, and red indicates those < 400 g/person/day, and blues countries for which EFSA do not hold data in their database.*

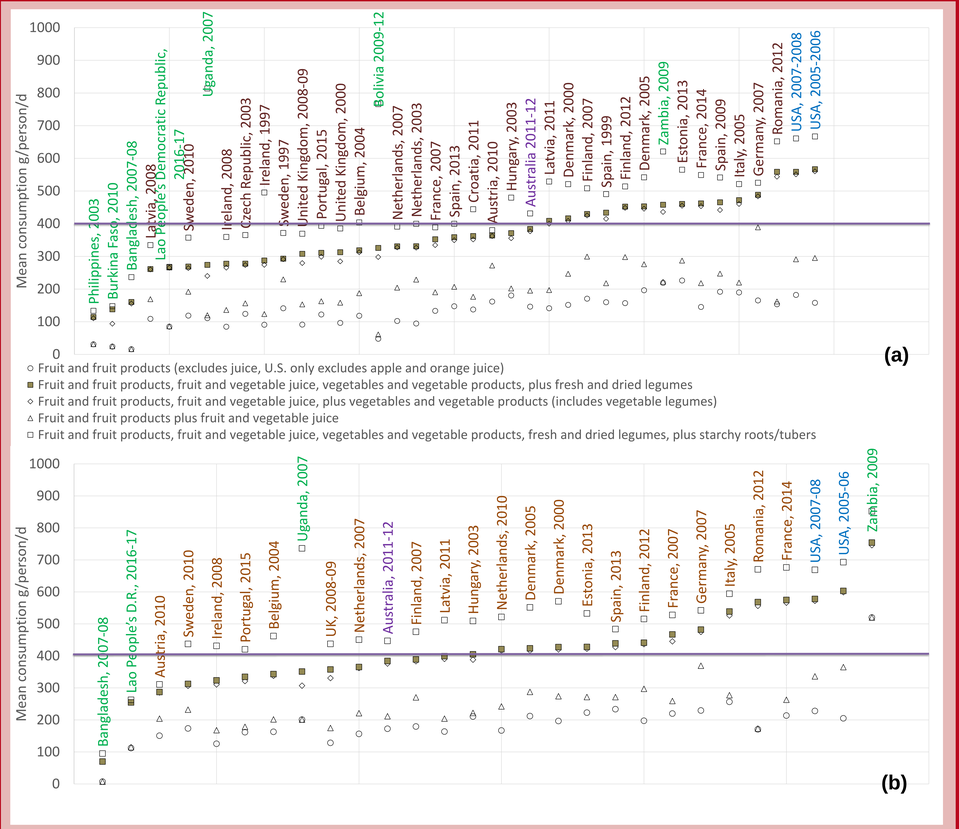


***Figure 2 a)*** *Adults,* ***b)*** *Elderly graph showing EFSA (brown text, a) 18-64 yrs, b) 65 – 74 yrs) [6], U.S. NHANES FICRCD (blue text, a) 20 yrs and over, b) 70 yrs and over) [7], Australian Health Survey (purple text, a) 19 years and over, b) 71 yrs and over) [8], and WHO/FAO GIFT (green text, a) 18-64 yrs, b) 65 yrs and over) [9] mean consumption data for fruit and fruit products (circles), plus fruit and vegetable juice (triangles), plus vegetables and vegetable products (including vegetable legumes (plus fresh legumes for non-EU countries)) (diamonds), plus legumes (non-EU countries as dried only) (solid squares), plus starchy roots and tubers (empty squares) (grams/person/day). The WHO recommended daily adult intake of fruit and vegetables (excluding starchy root/tubers, but including legumes up to 80 g/d, and up to ~1 serving / 150 ml 100% juice) of 400 g/d is shown by the line. Data is ranked by total fruit, juice, vegetables, legumes (solid squares).*

| Country EFSA database | Year | G cluster | Consumption total F+V+J+L mean (g/p/d) | Energy (kcal/d) | Dietary fiber (g/d) * | Potassium (mg/d) * | Calcium (mg/d)* | Magnesium (mg/d) | Phosphorus (mg/d) | Iron (mg/d) | Copper (mg/d) | Zinc (mg/d) | Manganese (mg/d)* | Selenium (µg/d) | RAE (µg/d) | Vitamin E (mg/d) | Vitamin K1 (µg/d)* | Thiamin (mg/d) | Riboflavin (mg/d) | Niacin (mg/d) | Vitamin B6 (mg/d) | Folate (µg/d) | Pantothenate (mg/d)* | Vitamin C (mg/d) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| U.S. RDAs (AI*) males | | | | | 38* | 4700* | 1000* | 400 | 700 | 8 | 0.9 | 11 | 2.3* | 55 | 900 | 15 | 120* | 1.2 | 1.3 | 16 | 1.3 | 400 | 5* | 90 |
| Finland A | 2012 | G07 | 452.5 | 212 | 12% | 16% | 7% | 11% | 13% | 16% | 18% | 4% | 22% | 1% | 16% | 7% | 36% | 45% | 9% | 11% | 21% | 22% | 18% | 109% |
| Finland E | 2012 | G07 | 441.1 | 216 | 16% | 15% | 6% | 10% | 12% | 15% | 18% | 4% | 22% | 1% | 18% | 7% | 31% | 38% | 9% | 10% | 15% | 21% | 17% | 101% |
| France A | 2014 | G07 | 462.3 | 211 | 15% | 20% | 11% | 13% | 17% | 25% | 25% | 7% | 26% | 5% | 21% | 10% | 56% | 36% | 10% | 12% | 25% | 29% | 18% | 82% |
| France E | 2014 | G07 | 574.8 | 250 | 26% | 24% | 12% | 14% | 21% | 30% | 30% | 8% | 29% | 5% | 23% | 13% | 63% | 38% | 12% | 14% | 24% | 37% | 22% | 94% |
| UK A | 2008 | G07 | 308.0 | 185 | 13% | 14% | 6% | 11% | 16% | 21% | 22% | 7% | 30% | 13% | 13% | 8% | 34% | 32% | 7% | 10% | 23% | 20% | 15% | 59% |
| UK E | 2008 | G07 | 357.6 | 191 | 19% | 16% | 6% | 11% | 17% | 22% | 25% | 7% | 31% | 12% | 18% | 9% | 48% | 31% | 9% | 12% | 20% | 23% | 18% | 64% |
| *Availability* | | *G07* | *584.4* | *202* | *20%* | *24%* | *12%* | *16%* | *23%* | *30%* | *29%* | *10%* | *34%* | *5%* | *31%* | *11%* | *70%* | *50%* | *14%* | *19%* | *34%* | *36%* | *30%* | *134%* |
| Austria A | 2010 | G08 | 364.1 | 269 | 8% | 17% | 6% | 10% | 11% | 19% | 17% | 4% | 23% | 2% | 8% | 5% | 26% | 27% | 7% | 9% | 20% | 15% | 14% | 81% |
| Austria E | 2010 | G08 | 287.1 | 191 | 9% | 11% | 4% | 7% | 8% | 12% | 13% | 3% | 19% | 2% | 6% | 4% | 43% | 19% | 6% | 6% | 12% | 12% | 10% | 66% |
| Germany A | 2007 | G08 | 488.6 | 476 | 10% | 31% | 10% | 18% | 18% | 40% | 20% | 5% | 45% | 3% | 10% | 7% | 25% | 35% | 10% | 14% | 26% | 16% | 18% | 141% |
| Germany E | 2007 | G08 | 482.1 | 409 | 16% | 25% | 8% | 15% | 17% | 35% | 22% | 5% | 38% | 3% | 11% | 7% | 36% | 28% | 10% | 12% | 19% | 17% | 18% | 114% |
| Spain A | 2013 | G08 | 358.7 | 174 | 12% | 14% | 7% | 10% | 13% | 17% | 21% | 5% | 22% | 4% | 10% | 8% | 48% | 36% | 9% | 10% | 16% | 22% | 14% | 70% |
| Spain E | 2013 | G08 | 439.2 | 216 | 20% | 16% | 7% | 11% | 15% | 21% | 27% | 6% | 24% | 5% | 12% | 9% | 48% | 38% | 10% | 12% | 15% | 25% | 17% | 93% |
| *Availability* | | *G08* | *588.2* | *198* | *21%* | *25%* | *13%* | *16%* | *22%* | *28%* | *35%* | *9%* | *34%* | *5%* | *31%* | *10%* | *97%* | *41%* | *13%* | *15%* | *37%* | *38%* | *28%* | *132%* |
| Croatia A | 2011 | G10 | 362.4 | 194 | 11% | 15% | 7% | 11% | 13% | 20% | 20% | 6% | 17% | 3% | 11% | 7% | 33% | 27% | 8% | 9% | 20% | 16% | 15% | 58% |
| Estonia A | 2013 | G10 | 460.6 | 241 | 14% | 18% | 8% | 12% | 13% | 21% | 23% | 5% | 24% | 3% | 16% | 7% | 28% | 30% | 10% | 11% | 27% | 19% | 18% | 79% |
| Estonia E | 2013 | G10 | 428.1 | 235 | 18% | 17% | 7% | 10% | 12% | 21% | 20% | 5% | 22% | 2% | 15% | 6% | 26% | 25% | 9% | 9% | 18% | 16% | 15% | 73% |
| Italy A | 2005 | G10 | 472.1 | 189 | 16% | 28% | 11% | 18% | 21% | 30% | 39% | 9% | 26% | 5% | 28% | 21% | 75% | 60% | 15% | 21% | 30% | 32% | 22% | 107% |
| Italy E | 2005 | G10 | 538.6 | 209 | 23% | 30% | 11% | 20% | 23% | 34% | 43% | 9% | 28% | 6% | 34% | 23% | 85% | 62% | 17% | 22% | 25% | 36% | 25% | 118% |
| Latvia A | 2011 | G10 | 408.7 | 214 | 14% | 17% | 11% | 12% | 13% | 31% | 21% | 6% | 27% | 3% | 25% | 8% | 33% | 31% | 8% | 9% | 23% | 22% | 14% | 74% |
| Latvia E | 2011 | G10 | 399.2 | 193 | 20% | 16% | 9% | 10% | 13% | 30% | 18% | 6% | 30% | 2% | 21% | 7% | 38% | 24% | 8% | 9% | 15% | 24% | 16% | 84% |
| *Availability* | | *G10* | *626.3* | *277* | *30%* | *28%* | *23%* | *23%* | *36%* | *53%* | *39%* | *15%* | *43%* | *6%* | *26%* | *12%* | *99%* | *51%* | *15%* | *18%* | *36%* | *44%* | *29%* | *141%* |
| Belgium A | 2004 | G11 | 318.6 | 162 | 10% | 15% | 6% | 10% | 12% | 15% | 20% | 4% | 18% | 3% | 14% | 10% | 33% | 37% | 8% | 11% | 19% | 18% | 13% | 69% |
| Belgium E | 2004 | G11 | 343.1 | 172 | 15% | 14% | 5% | 8% | 11% | 14% | 18% | 4% | 17% | 3% | 13% | 7% | 41% | 27% | 9% | 9% | 14% | 19% | 13% | 64% |
| Netherlands A | 2007 | G11 | 331.0 | 160 | 9% | 14% | 7% | 9% | 11% | 16% | 15% | 4% | 19% | 3% | 13% | 7% | 65% | 33% | 7% | 9% | 18% | 21% | 13% | 73% |
| Netherlands E | 2007 | G11 | 365.2 | 166 | 14% | 14% | 6% | 9% | 12% | 16% | 18% | 4% | 20% | 3% | 14% | 7% | 73% | 31% | 8% | 9% | 15% | 24% | 16% | 79% |
| *Availability* | | *G11* | *652.9* | *212* | *22%* | *27%* | *14%* | *17%* | *24%* | *31%* | *35%* | *11%* | *44%* | *7%* | *47%* | *11%* | *70%* | *43%* | *16%* | *17%* | *37%* | *41%* | *34%* | *132%* |
| Czech Republic A | 2003 | G15 | 277.9 | 146 | 10% | 10% | 6% | 6% | 9% | 17% | 15% | 3% | 13% | 2% | 7% | 4% | 33% | 21% | 6% | 7% | 16% | 12% | 10% | 53% |
| Denmark A | 2005 | G15 | 453.1 | 280 | 12% | 20% | 8% | 13% | 15% | 20% | 21% | 5% | 26% | 3% | 24% | 8% | 37% | 35% | 9% | 12% | 25% | 20% | 19% | 87% |
| Denmark E | 2005 | G15 | 423.6 | 271 | 15% | 19% | 6% | 11% | 13% | 19% | 20% | 4% | 24% | 2% | 18% | 7% | 33% | 31% | 9% | 10% | 17% | 18% | 17% | 82% |
| Hungary A | 2003 | G15 | 371.3 | 212 | 14% | 13% | 9% | 10% | 14% | 26% | 19% | 5% | 18% | 3% | 11% | 5% | 58% | 32% | 8% | 9% | 22% | 15% | 13% | 61% |
| Hungary E | 2003 | G15 | 405 | 226 | 20% | 14% | 8% | 9% | 15% | 26% | 20% | 6% | 18% | 2% | 12% | 6% | 72% | 33% | 9% | 9% | 17% | 17% | 13% | 60% |
| Ireland A | 2008 | G15 | 277.5 | 150 | 9% | 12% | 5% | 8% | 11% | 14% | 15% | 5% | 16% | 4% | 16% | 6% | 31% | 28% | 7% | 9% | 17% | 17% | 14% | 53% |
| Ireland E | 2008 | G15 | 323.5 | 159 | 14% | 14% | 6% | 9% | 13% | 16% | 18% | 5% | 18% | 3% | 21% | 7% | 40% | 30% | 7% | 10% | 15% | 19% | 15% | 62% |
| Portugal A | 2015 | G15 | 310.8 | 143 | 10% | 15% | 8% | 11% | 14% | 20% | 23% | 6% | 22% | 3% | 15% | 10% | 24% | 32% | 8% | 9% | 20% | 18% | 13% | 60% |
| Portugal E | 2015 | G15 | 334.6 | 150 | 14% | 15% | 7% | 11% | 14% | 21% | 24% | 6% | 22% | 2% | 17% | 10% | 23% | 30% | 8% | 9% | 16% | 20% | 14% | 64% |
| Romania A | 2012 | G15 | 558.8 | 292 | 19% | 25% | 13% | 15% | 20% | 37% | 30% | 9% | 27% | 5% | 33% | 14% | 91% | 40% | 11% | 16% | 30% | 31% | 21% | 98% |
| Romania E | 2012 | G15 | 568.2 | 265 | 24% | 26% | 11% | 14% | 20% | 37% | 31% | 8% | 27% | 4% | 34% | 15% | 95% | 35% | 11% | 15% | 22% | 31% | 21% | 97% |
| Sweden A | 2010 | G15 | 268.8 | 163 | 7% | 11% | 4% | 8% | 9% | 12% | 14% | 3% | 16% | 1% | 8% | 5% | 20% | 26% | 6% | 8% | 16% | 13% | 12% | 60% |
| Sweden E | 2010 | G15 | 312.5 | 174 | 12% | 12% | 4% | 8% | 10% | 12% | 16% | 3% | 16% | 1% | 10% | 6% | 18% | 28% | 7% | 8% | 13% | 15% | 12% | 70% |
| *Availability* | | *G15* | *620.1* | *222* | *23%* | *27%* | *14%* | *18%* | *26%* | *32%* | *33%* | *10%* | *38%* | *5%* | *31%* | *13%* | *104%* | *52%* | *14%* | *18%* | *41%* | *42%* | *30%* | *184%* |

***Table 1*** *Estimated percentage contribution of daily consumption of nutrients from total fruit, vegetables, fruit and vegetable juice, and legumes (determined and summed from the mean consumption of each individual product at level 7 in the EFSA database (A: adults 18-64 yrs, E: elderly 65-74 yrs) [6] and corresponding nutrient data in food conversion databases [10,11]) to meeting U.S. Recommended Dietary Allowances (RDAs) or Adequate Intakes (AIs *): availability and A /adults as males age 19-50 yrs, or E/ elderly as males aged 70 yrs and over [12].*


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