Nutritional and health benefits of plant-based eating

Ian Rowland
Department of Food & Nutritional Sciences
University of Reading UK
Overview

What is plant-based eating?
Food-based dietary guidelines
Current nutritional status in Europe
Can a plant-based diet help people meet dietary guidelines?
Benefits for health - CVD
What is plant-based eating?

**Vegans**
- Avoid all animal products

**Lacto-vegetarians**
- Avoid meat, fish and eggs, but eat dairy foods

**Lacto-ovo-vegetarians**
- Avoid meat and fish but eat dairy foods and eggs

**Pesco-vegetarians**
- Avoid meat but include fish and/or shellfish, dairy foods and eggs

**Semi vegetarian /Flexitarians**
- Eat small amounts of animal products

**Plant-based**
- At least 2/3 of the diet is made up of plant-based foods. Less than 1/3 comes from animal products.

Harland J & Garton L. The Plant-based Plan (2015)
Plant-based eating: huge variety of foods

- Pulses
- Wholegrains
- Vegetables
- Fruit
- Nuts and seeds
- Plant-based alternatives to meat and dairy

Harland J & Garton L. The Plant-based Plan (2015)
Plant-based Eating integrated in the food-based dietary guidelines

UK

The Netherlands
Plant-based Eating integrated in the food-based dietary guidelines - Belgium
Overview

- Plant-based eating: what is it?
- Food-based dietary guidelines
- Current nutritional status in Europe
- Can a plant-based diet help people meet dietary guidelines?
- Benefits for health - CVD
WHO recommendations for nutrient intake

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Target (g/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat (mg/day)</td>
<td>15 – 30</td>
</tr>
<tr>
<td>Saturated fat (PUFA) (g/day)</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>Cholesterol (mg/day)</td>
<td>&lt; 300</td>
</tr>
<tr>
<td>Protein (mg/day)</td>
<td>10 – 15</td>
</tr>
<tr>
<td>Fibre (g/day)</td>
<td>&gt; 25</td>
</tr>
</tbody>
</table>

Are these being achieved in Europe?
### Current Nutritional Status of Europe

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Fat (En%)</th>
<th>SFAs (En%)</th>
<th>PUFA (En%)</th>
<th>Cholesterol (mg/ day)</th>
<th>Protein (En%)</th>
<th>Fibre (g/ day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHO Recommendations</td>
<td>15-30</td>
<td>&lt; 10</td>
<td>6-11</td>
<td>&lt; 300</td>
<td>10-15</td>
<td>&gt; 25</td>
</tr>
</tbody>
</table>

#### NORTH

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>31.0 – 44.9</td>
<td>31.0 – 41.9</td>
<td>12.0 – 14.6</td>
<td>12.0 – 14.4</td>
<td>4.7 – 8.9</td>
<td>4.7 – 8.7</td>
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<tr>
<td></td>
<td>256.0 – 477.9</td>
<td>176.0 – 318.8</td>
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<td></td>
<td>13.7 – 16.8</td>
<td>13.7 – 17.2</td>
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<tr>
<td></td>
<td>18.0 – 25.0</td>
<td>15.6 – 21.0</td>
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</tbody>
</table>

#### SOUTH

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>28.4 – 45.0</td>
<td>29.9 – 47.2</td>
<td>8.8 – 12.7</td>
<td>9.4 – 13.2</td>
<td>4.8 – 6.4</td>
<td>4.5 – 6.9</td>
</tr>
<tr>
<td></td>
<td>282.9 – 378.4</td>
<td>2276 – 310.8</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>14.1 – 18.5</td>
<td>14.4 – 19.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>19.3 – 23.5</td>
<td>16.9 – 23.7</td>
<td></td>
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</tr>
</tbody>
</table>

Selected nutrient intakes (min-max) in adults across north and south European region compared with WHO recommendations.
Proportion of UK adults meeting dietary recommendations

- F&V*: 30%
- Fibre*: 16%
- Whole grains**: 17%
- Red meat*: 56%
- Total fat*: 50%
- Saturated fat*: 20%

* National Diet and Nutrition Survey: headline results from years 1 to 4 combined (2008/09 – 2011/12)
Major nutritional challenges in Europe

Can a plant based diet enable people to meet dietary guidelines?
# Food & Nutrient Intakes According to Pro-Vegetarian Eating Patterns

<table>
<thead>
<tr>
<th>Pro-vegetarian food pattern category</th>
<th>Very Low: &lt;30</th>
<th>Low: 30-40</th>
<th>Moderate: 35-39</th>
<th>High: 40-44</th>
<th>Very High: &gt;44</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food (g/day)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetables</td>
<td>254.0</td>
<td>294.0</td>
<td>343.0</td>
<td>388.0</td>
<td>442.0</td>
</tr>
<tr>
<td>Fruits</td>
<td>267.0</td>
<td>319.0</td>
<td>376.0</td>
<td>432.0</td>
<td>555.0</td>
</tr>
<tr>
<td>Legumes</td>
<td>15.0</td>
<td>18.0</td>
<td>21.0</td>
<td>25.0</td>
<td>28.0</td>
</tr>
<tr>
<td>Cereals</td>
<td>105.0</td>
<td>129.0</td>
<td>144.0</td>
<td>164.0</td>
<td>205.0</td>
</tr>
<tr>
<td>Nuts</td>
<td>4.4</td>
<td>7.2</td>
<td>10.0</td>
<td>14.0</td>
<td>22.0</td>
</tr>
<tr>
<td>Meats/meat products (excluding fish)</td>
<td>160.0</td>
<td>141.0</td>
<td>129.0</td>
<td>113.0</td>
<td>105.0</td>
</tr>
<tr>
<td>Dairy Products</td>
<td>495.0</td>
<td>419.0</td>
<td>371.0</td>
<td>314.0</td>
<td>259.0</td>
</tr>
<tr>
<td>Nutrients</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Fat (En%)</td>
<td>40.6</td>
<td>39.6</td>
<td>39.2</td>
<td>38.4</td>
<td>36.9</td>
</tr>
<tr>
<td>SFA (En%)</td>
<td>11.7</td>
<td>10.5</td>
<td>9.8</td>
<td>9.1</td>
<td>8.1</td>
</tr>
<tr>
<td>PUFA (En%)</td>
<td>5.8</td>
<td>6.1</td>
<td>6.3</td>
<td>6.5</td>
<td>6.8</td>
</tr>
<tr>
<td>Dietary Fibre (g/day)</td>
<td>19.0</td>
<td>22.0</td>
<td>26.0</td>
<td>30.0</td>
<td>36.0</td>
</tr>
</tbody>
</table>

+ve weighting given to
- Fruit
- Vegetables
- Nuts
- Cereals
- Legumes
- Olive oil
- Potatoes

-ve weighting given to
- Added animal fats
- Eggs
- Fish
- Dairy products
- Meats or meat products

TOTAL SCORE 12 - 60

*PREDIMED study, 7216 subjects (57%). Food intake by semi-quantitative FFQ. Pro-vegetarian food pattern emphasizes plant derived foods. Martinez-Gonzales, et al (2014) Am J Clin Nutr, 100(S1);320S*
Plant based eating → healthy balance of nutrients

- Plant-based eating patterns
  - tend to be low in total fat and SFA,
  - include a good level of unsaturated fats
  - leading to better overall fat quality,
  - are high in fibre
  - all in line with global dietary recommendations.
Overview

- Plant-based eating: what is it?
- Food-based dietary guidelines
- Current nutritional status in Europe
- Can a plant-based diet help people meet dietary guidelines?
- Benefits for health - CVD
Plant-based eating & benefits for health

- Weight management
- Cardiovascular benefits
- Managing blood glucose
- Healthy ageing
- Bone health
- Cancer incidence

Reduced risk of CVD
Plant-based eating & weight management

- Lower incidence of obesity ⇒ reduced risk of cardiovascular disease, diabetes and cancer

- AHS-2: The change from vegan diet to animal-based diets associated with a gradual increase in BMI.

- Plant-based foods have a lower energy density, are low in saturated fat and higher in fibre ⇒ all associated with lower body weight and less weight gain

After Sabate & Wein, Am J Clin Nutr 91, 1525S, 2010; Adventist Health Study-2
Good quality scientific studies demonstrate that plant-based eating is associated with a reduced risk of heart disease. Typically the incidence is ~ 20-30% lower in those following a plant-based eating pattern.

- Epi studies of vegetarians vs non-vegetarians
- Epi studies comparing plant-based eating patterns
- Mediterranean diet & CVD—epi and intervention studies
- Intervention studies with CVD biomarkers as endpoints
- Community-based interventions
Vegetarians vs non-vegetarians
Meta analysis of cohort studies

<table>
<thead>
<tr>
<th>Ischemic heart disease ID</th>
<th>ES (95% CI)</th>
<th>Weight %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key et al. [13], 2009</td>
<td>0.83 (0.59, 1.18)</td>
<td>12.08</td>
</tr>
<tr>
<td>Thorogood et al. [23], 1994</td>
<td>0.90 (0.68, 1.20)</td>
<td>13.31</td>
</tr>
<tr>
<td>Chang-Claude et al. [2], 2005</td>
<td>0.78 (0.73, 0.84)</td>
<td>20.12</td>
</tr>
<tr>
<td>Beeson et al. [18], 1989</td>
<td>0.62 (0.53, 0.73)</td>
<td>19.07</td>
</tr>
<tr>
<td>Berkel and de Waard [24], 1983</td>
<td>0.43 (0.35, 0.52)</td>
<td>19.48</td>
</tr>
<tr>
<td>Key et al. [26], 1996</td>
<td>0.85 (0.68, 1.06)</td>
<td>15.94</td>
</tr>
<tr>
<td>Overall (I² = 30.8%, p = 0.076)</td>
<td>0.71 (0.56, 0.87)</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Note: weights are from random effects analysis

29% reduction in risk

6 studies (~120,000 subjects) from UK, Germany, Netherlands, USA, Huang et al Ann Nutr Metab 60:233, 2012 (ES= effect size)
All cause & CVD mortality across increasing plant-based eating patterns

<table>
<thead>
<tr>
<th>Pro-veg food pattern category</th>
<th>Adjusted HR</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>all cause</td>
<td>CVD</td>
</tr>
<tr>
<td>Very low</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Low</td>
<td>0.71</td>
<td>0.48</td>
</tr>
<tr>
<td></td>
<td>(0.50,1.02)</td>
<td>(0.24, 0.99)</td>
</tr>
<tr>
<td>Moderate</td>
<td>0.68</td>
<td>0.44</td>
</tr>
<tr>
<td></td>
<td>(0.48, 0.96)</td>
<td>(0.22, 0.90)</td>
</tr>
<tr>
<td>High</td>
<td>0.59</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td>(0.40, 0.88)</td>
<td>(0.21,1.02)</td>
</tr>
<tr>
<td>P trend</td>
<td>0.027</td>
<td>0.039</td>
</tr>
</tbody>
</table>

PREDIMED study, 7216 subjects (57%) at high CVD risk. Follow up for 4.8y: 323 deaths (76 from CVD).
Mediterranean diet and lifestyle – a good example of plant based eating

Traditional Mediterranean diet is part of a lifestyle incorporating

- High intake of fruit and veg
- High intake of whole grains and nuts
- Low amounts of red meat, refined CHO
- High consumption extra virgin olive oil

In the Mediterranean region:

Plant based eating
CVD cancer diabetes
The aMed score is a Mediterranean diet scale.

Higher the score (0-9) the closer to Med diet.

Points given for intake above median for Med diet components inc moderate alcohol, (or below for red meat).

Nurses’ Health study (n=74886; 5231 CVD cases)

Adjusted RR of CVD incidence & death by quintiles of aMed.

Med diet and CVD risk- Intervention study vs prudent (low fat) diet

180 subjects with metabolic syndrome followed Med diet (whole grain, F&V, olive oil) or prudent diet (CHO 50-60%, fat <30%) for 2 years

Exposito et al JAMA. 2004;292(12):1440-1446
Interventions: Portfolio Diet studies (Jenkins et al):

- Diet based on plant foods: soya protein, nuts, viscous fibre (oats), plant stanols/sterols
- ~12 studies, 4 – 80 weeks in duration
- LDL-C reductions 7 - 30% (P<0.001)
- In longer term and more practical environment ↓ ~15% + improved Total: HDL-C ratio (P<0.001)
- Limited evidence ↓ BP
Plant-based eating & CVD markers

Community-based interventions

• 4 community-based (uncontrolled) lifestyle interventions with plant based diets
  ➔ Reduction in LDL-C of 7-15% vs baseline
  ➔ Reduction in SDP and DBP of ~ 5%

Chainani-Wu et al, Am J Cardiol 108, 498, (2011)
Factors involved

Health benefits of plant-based eating usually attributed to the wide variety of nutrients (fibre, complex carbohydrates, mono- and poly-unsat fats, plant proteins, vitamins and minerals) and non-nutrients (eg polyphenols) found in plant-based foods.

**LIGNANS**
(pinoresinol, lariciresinol)

- Olive oil, cereals, seeds,

**SECOIRIDOIDS**
(hydroxytyrosol, oleuropein)

- Olive oil, olives, wine

**FLAVONOIDs**
(epicatechin, quercetin, naringenin)

- Berries, citrus fruits, onions, red wine, tea, cocoa

**CAROTENOIDS**
(B-carotene, lycopene)

- Tomato, carrots, mango
Flavonoids and CVD risk

<table>
<thead>
<tr>
<th>Flavonoid group</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthocyanidins</td>
<td>0.89 (0.83, 0.96)</td>
</tr>
<tr>
<td>Proanthocyanidins</td>
<td>0.90 (0.82, 0.98)</td>
</tr>
<tr>
<td>Flavones</td>
<td>0.88 (0.82, 0.96)</td>
</tr>
<tr>
<td>Flavanones</td>
<td>0.88 (0.82, 0.96)</td>
</tr>
<tr>
<td>Flavan-3-ols</td>
<td>0.87 (0.80, 0.95)</td>
</tr>
</tbody>
</table>

- Meta analysis of 14 prospective cohort studies
- Wang et al BJN 111, 1-11, 2014
### Olive polyphenols and CV risk markers

<table>
<thead>
<tr>
<th>Blood pressure (mmHg)</th>
<th>24h SBP</th>
<th>3.33</th>
<th>p=0.045</th>
</tr>
</thead>
<tbody>
<tr>
<td>24h DBP</td>
<td>2.42</td>
<td></td>
<td>p= 0.039</td>
</tr>
<tr>
<td>Lipids %</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>TC</td>
<td>6.5%</td>
<td>p&lt;0.05</td>
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<tr>
<td>LDL-C</td>
<td>6.4%</td>
<td>P&lt;0.05</td>
<td></td>
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<tr>
<td>TG</td>
<td>3.7%</td>
<td>p&lt;0.05</td>
<td></td>
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<tr>
<td>Inflammatory markers pg/ml</td>
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<td></td>
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<tr>
<td>IL-8</td>
<td>0.63</td>
<td>p=0.03</td>
<td></td>
</tr>
<tr>
<td>TNFalpha</td>
<td>0.50</td>
<td>p=0.10</td>
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<tr>
<td>IL-1B, IL-6, CRP</td>
<td>⇔</td>
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Randomized, double blind, placebo-controlled, cross-over human trial 60 men, 18-65y, given olive polyphenol extract for 6 wk
Lockyer et al Eur J Nutr 56, 1421-1432, 2017
Summary

Plant-based eating patterns:

- Tend to be low in total fat & sat fat, good level of unsaturated fats, high in fibre - thus can help consumers achieve healthful diet recommendations
- have a role in maintaining body weight / lower prevalence of obesity
- are associated with a lower overall mortality
- are associated lower CVD risk, typically by ~ 20-30%
- Improve CVD risk factors (LDL-C, HDL-C, BP, TG) thus contribute to a healthy heart
- Specific components found intrinsically in plant foods are thought to be involved, e.g. fibre, phytosterols, polyphenols
Acknowledgements

Alpro Foundation

Lynne Garton
Janice Harland