Health benefits of cereal foods and components in our daily diet - an overview

Gabriele Riccardi, MD, FAHA
Full Professor of Endocrinology and Metabolic Diseases
Director of the Master Course on Human Nutrition
Federico II University, Naples, Italy
Outline

• Epidemiological evidence
• Intervention trials
• Sustainability
• Recommendations
Habitual consumption of whole grain is associated with a lower incidence of Coronary Diseases.
Dose-response relationship between quintiles of whole grain consumption and Cardiovascular Disease mortality

Hazard Ratio + 95% confidence intervals

Wu H et al. – JAMA Intern Med, 2015
Habitual whole grain consumption is associated with a lower risk of type 2 diabetes: meta-analysis of cohort studies

An inverse dose-response relationship exists between whole grain consumption and the risk of type 2 diabetes: dose-response meta-analysis of cohort studies

Most of the benefits were observed up to an intake of two servings per day

Habitual refined grain consumption is not associated with the risk of type 2 diabetes: meta-analysis of cohort studies

There is no relationship between habitual refined grain consumption and the risk of type 2 diabetes: dose-response meta-analysis of cohort studies

Habitual whole grain consumption is associated with a lower mortality for cancer with a dose-response relationship. The NIH-AARP Health Study.

Table 2 Association of whole grain intake with total and cause-specific mortality

<table>
<thead>
<tr>
<th>Causes of death</th>
<th>All participants</th>
<th>Whole grains (oz eq/d)</th>
<th>Q1 (n = 41,248)</th>
<th>Q2 (n = 41,248)</th>
<th>Q3 (n = 41,249)</th>
<th>Q4 (n = 41,248)</th>
<th>Q5 (n = 41,249)</th>
<th>P trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer</td>
<td>No. of deaths</td>
<td>19,043</td>
<td>4,772</td>
<td>3,974</td>
<td>3,616</td>
<td>3,391</td>
<td>3,290</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Model 1</td>
<td>1.00</td>
<td>0.81 (0.78–0.85)</td>
<td>0.72 (0.69–0.76)</td>
<td>0.66 (0.63–0.69)</td>
<td>0.61 (0.59–0.64)</td>
<td>&lt;0.0001</td>
<td></td>
</tr>
</tbody>
</table>

Huang T et al, BMC Medicine, 2015
Outline

• Epidemiological evidence
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Intervention studies are not always concordant with epidemiological observations in relation to the health benefits of habitual whole grain consumption.

**Increased Whole Grain Consumption Does Not Affect Blood Biochemistry, Body Composition, or Gut Microbiology in Healthy, Low-Habitual Whole Grain Consumers**

Antonios Ampatzoglou, Kiranjit K Atwal, Catherine M Maidens, Charlotte L Williams, Alastair B Ross, Frank Thielecke, Satya S Jonnalagadda, Orla B Kennedy, and Parveen Yaqoob

- **Starchy endosperm (80-85%)**
  - proteins & starch

- **Aleurone layer (6-9%)**
  - Soluble & insoluble dietary fibre (xylans, β-glucans)
  - Proteins
  - Antioxidants (phenolic acids)
    - Vitamin E
    - B vitamins
    - Minerals
    - Phytic acid
    - Enzymes

- **Testa (1%)**
  - Alkylresorcinols

- **Germ (3%)**
  - Lipids
  - Antioxidants
  - Vitamin E
  - B vitamins
  - Minerals
  - Plant sterols
  - Enzymes

- **Inner and Outer pericarp (4-5%)**
  - Insoluble dietary fibre (xylans, cellulose, lignin)
  - Antioxidants bound to cell walls (phenolic acids)
How carbohydrate digestion can modulate post-prandial metabolism

- Carbohydrate foods
  - Stomach
    - Gastric emptying
    - Small intestine
      - Rate of glucose absorption
  - Colon
    - Gut microbiota
      - Subclinical inflammation
      - Whole grains
        - SCFA
  - Satiety
    - CCK
    - GIP
    - GLP-1

- Body Fat
  - Glucose
  - Insulin
  - FFA
  - TG

- Rate of glucose absorption

- Subclinical inflammation
**Study design**

**Control Diet Group (refined cereals)**  N=26

**Whole Grain Diet Group (whole grain cereals)**  N=28

- Randomization
- 7-day food record

0  4 wk  8 wk  12 wk

- 7-day food record  7-day food record  7-day food record

**Fasting measurements**

+ **Postprandial measurements**

(Standardized meal: refined cereals)

**Fasting measurements**

+ **Postprandial measurements**

(Standardized meal: refined or whole grain cereals)
A diet rich in whole grains improves insulin action and reduces plasma triglycerides levels in the postprandial period

Refined cereals (n=26) vs Wholegrain cereals (n=28)

- **Plasma Glucose**
  - Mean increment for 2 hrs
  - Run-in: 20 mg/dL
  - 3 months: 30 mg/dL
  - Δ = +10%
  - *p = 0.04

- **Plasma Insulin**
  - Mean increment for 2 hrs
  - Run-in: 50 μU/mL
  - 3 months: 40 μU/mL
  - Δ = -29%
  - *p = 0.04

- **Plasma Triglyceride**
  - Mean increment for 3 hrs
  - Run-in: 75 mg/dL
  - 3 months: 50 mg/dL
  - Δ = -43%
  - *p = 0.001

* *p < 0.05 vs 12 week (Paired Sample t-test)
The postprandial triglyceride response is inversely correlated with fasting plasma alkylresorcinol levels (AR)

\[ r = -0.332 \]
\[ p = 0.014 \]

Giacco R et al. – NMCD, 2014
The post-prandial insulin rise is reduced in the presence of higher fasting plasma propionate levels

Data are expressed as mean ± SEM.
Black: values below the median, white: values above the median.
*p=0.020 (vs below the median; one-way ANOVA)
(† end of the trial minus baseline)

Vetrani C et al. – Nutrition, 2015 (in press)
Outline

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The life cycle assessment of pasta and red meat
## Impact of food production on CO2 emissions

<table>
<thead>
<tr>
<th>Product</th>
<th>Carbon footprint kg CO2-eq./kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef</td>
<td>46.7</td>
</tr>
<tr>
<td>Cheese, Gouda</td>
<td>9.2</td>
</tr>
<tr>
<td>Pork</td>
<td>7.7</td>
</tr>
<tr>
<td>Chicken</td>
<td>5.1</td>
</tr>
<tr>
<td>Salmon</td>
<td>3.9</td>
</tr>
<tr>
<td>Egg</td>
<td>3.3</td>
</tr>
<tr>
<td>Herring</td>
<td>2.0</td>
</tr>
<tr>
<td>Tomato</td>
<td>1.7</td>
</tr>
<tr>
<td>Cashew nuts</td>
<td>1.6</td>
</tr>
<tr>
<td>Milk, semi-skimmed</td>
<td>1.2</td>
</tr>
<tr>
<td>Crispbread</td>
<td>1.0</td>
</tr>
<tr>
<td>Bread, white</td>
<td>1.0</td>
</tr>
<tr>
<td>Bread, rye</td>
<td>0.9</td>
</tr>
<tr>
<td>Bread, wholemeal</td>
<td>0.9</td>
</tr>
<tr>
<td>Carrots</td>
<td>0.7</td>
</tr>
<tr>
<td>Potatoes</td>
<td>0.7</td>
</tr>
<tr>
<td>Cereal, wholegrain</td>
<td>0.7</td>
</tr>
<tr>
<td>Apple</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Blonk Consultants, 2015
Access to sufficient, nutritious, and safe food is an essential element of food security for the U.S. population. A sustainable diet ensures this access for both the current population and future generations. The major findings regarding sustainable diets were that a diet higher in plant-based foods, such as vegetables, fruits, whole grains, legumes, nuts, and seeds, and lower in calories and animal based foods is more health promoting and is associated with less environmental impact than is the current U.S. diet. This pattern of eating can be achieved through a variety of dietary patterns, including the Healthy U.S.-style Pattern, the Healthy Mediterranean-style Pattern, and the Healthy Vegetarian Pattern.

2015 USDA Scientific report for the Dietary Guidelines for Americans
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There is convincing evidence that myristic and palmitic acids, trans fatty acids, high sodium intake, overweight and high alcohol intake contribute to an increase in risk of cardiovascular diseases. A “probable” level of evidence demonstrates a decreased risk for a-linolenic acid, oleic acid, NSP, wholegrain cereals, nuts.
Dietary recommendation for childhood and adolescence: Grains

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Amount (ounces)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2-3</td>
<td>3</td>
</tr>
<tr>
<td>4-8</td>
<td>M: 5</td>
</tr>
<tr>
<td></td>
<td>F: 4</td>
</tr>
<tr>
<td>9-13</td>
<td>M: 6</td>
</tr>
<tr>
<td></td>
<td>F: 5</td>
</tr>
<tr>
<td>14-18</td>
<td>M: 7</td>
</tr>
<tr>
<td></td>
<td>F: 6</td>
</tr>
</tbody>
</table>

Half of the all grains should be whole
Dietary recommendation during pregnancy and breastfeeding: Grains

<table>
<thead>
<tr>
<th>Food Group</th>
<th>1st Trimester</th>
<th>2nd and 3rd Trimesters</th>
<th>What counts as 1 cup or 1 ounce?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains</td>
<td>6 ounces</td>
<td>8 ounces</td>
<td>1 slice bread 1 ounce ready-to-eat cereal ½ cup cooked pasta, rice, or cereal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Breastfeeding only</th>
<th>Breastfeeding plus formula</th>
<th>What counts as 1 cup or 1 ounce?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains</td>
<td>8 ounces</td>
<td>6 ounces</td>
<td>1 slice bread 1 ounce ready-to-eat cereal ½ cup cooked pasta, rice, or cereal</td>
</tr>
</tbody>
</table>

- Consume at least half of all grains as whole grains.
- Increase whole-grain intake by replacing refined grains with whole grains.
Take home messages

- Wholegrain cereal consumption is associated with a lower risk of major Chronic Non Communicable Diseases (type 2 diabetes, CVD, cancer)
- Dietary fiber and polyphenols (present in wholegrain cereals) may influence colonic microbiota and SCFA production, thus modulating glucose and lipid metabolism as well as energy intake
- A diet high in plant-based foods, including cereals and, particularly, whole grain, is associated with less environmental impact than a western diet, presently utilized in many European countries.
- Increased consumption of whole grain foods (at least one or two servings /day) should be recommended to the general population, irrespective of age, gender and physiological state
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...AT WORK!
Thank you for your attention