Whole Grains and Health: A Roundup of the Latest Research

Penny M. Kris-Etherton, PhD, RD
Distinguished Professor of Nutrition
Department of Nutritional Sciences
Pennsylvania State University
Outline

- Whole grain benefits
  - CVD
  - Weight Management
  - Diabetes & Metabolic Syndrome
  - Cancer
- Benefits go beyond fiber
  - Bran, endosperm, germ
  - Antioxidants, polyphenols, phytosterols
Whole Grain Foods

- Whole wheat and whole wheat flour
- Whole oats and whole oat flour
- Whole cornmeal and whole corn flour
- Brown rice and brown rice flour
- Whole rye and whole rye flour
- Whole barley
- Bulgur
- Buckwheat
- Popcorn
- Amaranth
- Psyllium
Inverse Association Between Whole Grain Intake and Cardiovascular Disease


1 Demographic adjusted model
2 Demographic plus risk factor adjusted model
## Summary of Large-Scale Observational Studies Showing a Benefit of Increased Whole Grain Consumption on CVD Risk*

<table>
<thead>
<tr>
<th>Study Data Source</th>
<th>Reported Association/Outcome</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Professionals Follow-Up (42,850 adult men), 14 years of follow-up</td>
<td>18% reduction in coronary heart disease</td>
<td>(Jensen et al 2004)</td>
</tr>
<tr>
<td>Nurse’s Health Study (75,521 adult women), up to 12 years follow-up</td>
<td>36% reduction in ischemic stroke</td>
<td>(Liu et al 2000)</td>
</tr>
<tr>
<td>Iowa Women’s Health Study (38,470 postmenopausal women), 9 years of follow-up</td>
<td>18% reduction in all cardiovascular disease deaths</td>
<td>(Jacobs et al 1999)</td>
</tr>
<tr>
<td>Iowa Women’s Health Study (34,491 postmenopausal women), 9 years of follow-up</td>
<td>18% reduction in coronary heart disease</td>
<td>(Jacobs et al 1998)</td>
</tr>
<tr>
<td>Iowa Women’s Health Study (34,491 postmenopausal women), 9 years of follow-up</td>
<td>30% reduction in ischemic heart disease death</td>
<td>(Jacobs et al 1998)</td>
</tr>
<tr>
<td>U.S., Boston adult 535 men and women</td>
<td>52% reduction in CVD mortality</td>
<td>(Sahyoun et al 2006)</td>
</tr>
<tr>
<td>Atherosclerosis Risk in Communities (ARIC) Study (15,972 adult men and women), 11 year follow-up</td>
<td>23% reduction in all-cause mortality</td>
<td>(Steffen et al 2003)</td>
</tr>
<tr>
<td></td>
<td>28% reduction in incident coronary artery</td>
<td></td>
</tr>
</tbody>
</table>

*Only significant differences are reported unless otherwise stated (P < 0.05).*
Whole Grains & Stroke: Epidemiological Evidence

- Harvard Nurses’ Health Study (75,000 women)

  3 servings of whole grain food/day

  36% ↓ risk of ischemic stroke (24% after controlling for fiber)

Liu et al., JAMA. 2000;284:1534-1540.
Whole Grain Intake and Incident of Hypertension In Men: Health Professionals Follow-Up Study, 1986-2004

<table>
<thead>
<tr>
<th></th>
<th>Quintile of whole grain intake</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>P for trend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median intake (g/d)</td>
<td>3.3</td>
<td>9.8</td>
<td>17.1</td>
<td>26.9</td>
<td>46.0</td>
<td>—</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>No. of cases</td>
<td>1826</td>
<td>1917</td>
<td>1922</td>
<td>1914</td>
<td>1648</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Person-years</td>
<td>61,137</td>
<td>68,966</td>
<td>72,196</td>
<td>73,184</td>
<td>69,877</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Age- and energy-</td>
<td>1.00</td>
<td>0.90</td>
<td>0.83</td>
<td>0.81</td>
<td>0.72</td>
<td>&lt;0.0001</td>
<td></td>
</tr>
<tr>
<td>adjusted RR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multivariate-</td>
<td>1.00</td>
<td>0.94</td>
<td>0.89</td>
<td>0.89</td>
<td>0.81</td>
<td>&lt;0.0001</td>
<td></td>
</tr>
<tr>
<td>adjusted RR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Whole Grains & Heart Disease: Effect on Blood Lipids

Whole grains lower cholesterol levels in part because of a high level of viscous (soluble) fiber

- Oats added to diet DeGroot et al., 1963
  • ↓ **cholesterol 5-8%**
- Whole grain cereal & AHA Step One diet Johnston et al., 1998
  • ↓ **cholesterol 4%**
- FDA Health Claim - 3 grams of viscous (soluble) fiber from whole grain oats or oat bran
  • ↓ **cholesterol 5-6mg/dL** Ripsin et al., 1992
- Whole wheat vs refined wheat Giacco et al., 2009
  • ↓ **cholesterol 4%**
Whole Grains & CVD Risk Reduction: Potential Mechanisms

- Soluble Fiber
- LDL Oxidation
- Vascular Reactivity
- Coagulation and Fibrinolysis
- Insulin Sensitivity
- Homocysteine
### Whole Grains & Obesity: Epidemiological Studies

**NHANES 1999-2000**

Whole Grain (WG) Intake (sv/d) Inversely Associated with BMI and Waist Circumference in Adult Women

<table>
<thead>
<tr>
<th></th>
<th>WG = 0 sv/d</th>
<th>O &lt; WG &lt;1 sv/d</th>
<th>WG ≥1 sv/d</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BMI</strong></td>
<td>29.0 ± 0.3</td>
<td>28.2 ± 0.4</td>
<td>27.1 ± 0.5&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Waist Circumference</strong></td>
<td>93.9 ± 0.9</td>
<td>91.8 ± 1.1</td>
<td>90.3 ± 1.3&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> Means with superscripts are significantly different from 0 WG servings/day, p<0.05

---

Good et al., JACN. 2008;27:80-87.
Whole Grains & Obesity: Epidemiological Studies

Higher Whole Grain (WG) Intake (3 servings/day) is associated with Lower BMI

Fig. 2 Mean difference in body mass index ($\Delta$BMI) in non- or low consumers of whole grains compared with high consumers of whole grains (95% confidence interval shown by vertical bars)

**Whole Grains and Waist Circumference: Epidemiological Studies**

Higher Whole Grain (WG) Intake (3 servings/day) is associated with Lower Central Adiposity

<table>
<thead>
<tr>
<th>Study name</th>
<th>Subgroup within study</th>
<th>Statistics for each study</th>
<th>Difference in means</th>
<th>Standard error</th>
<th>Lower limit</th>
<th>Upper limit</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esmailzadeh et al.(23)</td>
<td>WHR</td>
<td></td>
<td>0.050</td>
<td>0.008</td>
<td>0.034</td>
<td>0.066</td>
<td>0.000</td>
</tr>
<tr>
<td>Jacobs et al.(33)</td>
<td>WHR</td>
<td></td>
<td>0.016</td>
<td>0.001</td>
<td>0.013</td>
<td>0.019</td>
<td>0.000</td>
</tr>
<tr>
<td>McKeown et al.(31)</td>
<td>WHR</td>
<td></td>
<td>0.030</td>
<td>0.006</td>
<td>0.018</td>
<td>0.042</td>
<td>0.000</td>
</tr>
<tr>
<td>Steffen et al.(39)</td>
<td>WHR</td>
<td></td>
<td>0.016</td>
<td>0.001</td>
<td>0.013</td>
<td>0.019</td>
<td>0.000</td>
</tr>
<tr>
<td>Mean random-effects model</td>
<td></td>
<td></td>
<td>0.023</td>
<td>0.003</td>
<td>0.016</td>
<td>0.030</td>
<td>0.000</td>
</tr>
<tr>
<td>Esmailzadeh et al.(23)</td>
<td>WC</td>
<td></td>
<td>0.050</td>
<td>0.001</td>
<td>0.048</td>
<td>0.052</td>
<td>0.000</td>
</tr>
<tr>
<td>McKeown et al.(31)</td>
<td>WC</td>
<td></td>
<td>0.020</td>
<td>0.008</td>
<td>0.006</td>
<td>0.035</td>
<td>0.000</td>
</tr>
<tr>
<td>Steffen et al.(39)</td>
<td>WC</td>
<td></td>
<td>0.046</td>
<td>0.017</td>
<td>0.013</td>
<td>0.079</td>
<td>0.006</td>
</tr>
<tr>
<td>Steffen et al.(39)</td>
<td>WC</td>
<td></td>
<td>0.050</td>
<td>0.006</td>
<td>0.039</td>
<td>0.061</td>
<td>0.000</td>
</tr>
<tr>
<td>Thane et al.(35) M</td>
<td>WC</td>
<td></td>
<td>0.010</td>
<td>0.001</td>
<td>0.008</td>
<td>0.012</td>
<td>0.000</td>
</tr>
<tr>
<td>Thane et al.(35) F</td>
<td>WC</td>
<td></td>
<td>-0.010</td>
<td>0.001</td>
<td>-0.012</td>
<td>-0.008</td>
<td>0.000</td>
</tr>
<tr>
<td>Mean random-effects model</td>
<td></td>
<td></td>
<td>0.027</td>
<td>0.013</td>
<td>0.002</td>
<td>0.052</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Mean difference (and 95% confidence interval, CI) in waist:hip ratio (WHR) or waist circumference (WC) when low or no whole-grain intake is compared with high intake

Means and percentages of body mass index and insulin, by category of whole grain intake, MESA 2000–2002

<table>
<thead>
<tr>
<th>Whole Grain Intake Category</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>P trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median whole grain intake</td>
<td>0.02</td>
<td>0.15</td>
<td>0.39</td>
<td>0.72</td>
<td>1.39</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>1069</td>
<td>1137</td>
<td>1072</td>
<td>1121</td>
<td>1097</td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>28.2</td>
<td>28.2</td>
<td>27.9</td>
<td>27.8</td>
<td>27.6</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Insulin</td>
<td>5.37</td>
<td>5.42</td>
<td>5.42</td>
<td>5.19</td>
<td>5.16</td>
<td>&lt;0.002</td>
</tr>
</tbody>
</table>

Whole Grains & Obesity: Potential Mechanisms

- High volume, high fiber, low energy density
- Prolonged gastric emptying
- Increased insulin sensitivity
- Secretion of gut hormones
Whole-grain intake is inversely associated with the metabolic syndrome and mortality in older adults

The study population was composed of 179 (33%) men and 356 (67%) women with an average age of 72.1 y for men and 73.4 y for women.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Grain intake</th>
<th></th>
<th></th>
<th></th>
<th>$P$ for trend$^1$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
<td></td>
</tr>
<tr>
<td>Whole grain</td>
<td>135</td>
<td>132</td>
<td>135</td>
<td>133</td>
<td></td>
</tr>
<tr>
<td>$n$</td>
<td>135</td>
<td>132</td>
<td>135</td>
<td>133</td>
<td>0.001</td>
</tr>
<tr>
<td>Median whole grain intake (servings/d)$^2$</td>
<td>0.31</td>
<td>0.86</td>
<td>1.49</td>
<td>2.90</td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m$^2$)</td>
<td>26.4</td>
<td>25.5</td>
<td>25.3</td>
<td>25.2</td>
<td>0.03</td>
</tr>
<tr>
<td>Glucose (mg/dL)</td>
<td>114.9</td>
<td>113.1</td>
<td>111.5</td>
<td>108.5</td>
<td>0.01</td>
</tr>
<tr>
<td>Metabolic syndrome (Odds ratios)</td>
<td>1.00</td>
<td>0.58</td>
<td>0.41</td>
<td>0.46</td>
<td>0.005</td>
</tr>
</tbody>
</table>

Whole Grains & Type 2 Diabetes: Epidemiological Studies

Date from the IOWA Women’s Health Study

Intake of about 3 servings of whole grains/day

21 % ↓ risk of Type 2 diabetes

Data from the Nurses’ Health Study

27 % ↓ risk of Type 2 diabetes
Inverse Association Between Whole Grain Intake and Type 2 Diabetes

de Munter et al., PLOS Medicine. 2007;4;e261:1385-1395.
Whole Grains & Type 2 Diabetes: Potential Mechanisms

- Activity of components including fiber, magnesium, vitamin E, phytic acids, phenolic compounds
- Short-chain fatty acids
- Viscous fibers
- Antioxidant activity
Whole Grain Consumption Inversely Associated with Colorectal Cancer Risk*

<table>
<thead>
<tr>
<th>Study</th>
<th>Relative Risk (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuchs et al., 1999</td>
<td>1.23 (0.70-1.76)</td>
</tr>
<tr>
<td>Pietinen et al., 1999</td>
<td>1.00 (0.64-1.36)</td>
</tr>
<tr>
<td>Terry et al., 2001 (Prudent Diet)</td>
<td>0.79 (0.43-1.15)</td>
</tr>
<tr>
<td>Terry et al., 2001</td>
<td>0.91 (0.63-1.19)</td>
</tr>
<tr>
<td>Bingham et al. 2003</td>
<td>0.78 (0.55-1.01)</td>
</tr>
<tr>
<td>Fung et al., 2003 (Prudent Diet)</td>
<td>0.71 (0.35-1.07)</td>
</tr>
<tr>
<td>Fung et al., 2003</td>
<td>1.46 (1.05-1.87)</td>
</tr>
<tr>
<td>Mai et al., 2003</td>
<td>1.02 (0.73-1.31)</td>
</tr>
<tr>
<td>McCullough et al., 2003</td>
<td>1.17 (0.70-1.64)</td>
</tr>
<tr>
<td>Bingham et al., 2005</td>
<td>0.93 (0.72-1.14)</td>
</tr>
<tr>
<td>Larsson et al., 2005</td>
<td>0.80 (0.51-1.09)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>0.94 (0.85-1.03)</strong></td>
</tr>
</tbody>
</table>

*11 cohort studies; 1,719,590 participants (25 to 70 years of age)
Association between whole-grain intake and risk of colorectal cancer

# Observational Studies Showing a Benefit of Increased Whole Grain Consumption on Cancer Risk*

<table>
<thead>
<tr>
<th>Study Data Source</th>
<th>Reported Association/Outcome</th>
<th>Reference</th>
</tr>
</thead>
</table>
| National Institutes of Health and AARP Diet and Health Study (291,988 men and 197,623 women) 5 year follow-up (U.S. population) | 14% reduction in colon cancer risk  
15% reduction in distal colon cancer risk  
36% reduction in rectal cancer risk  
Trend for reduction in proximal; colon cancer risk | (Schatzkin et al 2007) |
| National Institutes of Health and AARP Diet and Health Study (293,703 men and 198,618 women) 5 year follow-up (U.S. population) | 41% reduction in small intestinal cancer risk                                                | (Schatzkin et al 2008) |
| Population-based case-cohort study  
532 incident cases 1,701 controls (U.S. population) | 40% reduction in pancreatic cancer risk                                                      | (Chan et al 2007)   |
| Swedish Mamography Cohort  
(61,433 women over 40 yrs)  
14.6 year follow-up (Swedish population)            | 33% reduction in colon cancer risk                                                           | (Larsson et al 2005) |

*Only significant differences are reported unless otherwise stated (P < 0.05) for fully adjusted models.*
Relative Risks of Small Intestinal Cancer by Quintiles of Dietary Fiber and Whole Grain Intakes

<table>
<thead>
<tr>
<th></th>
<th>Quintile of intake</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Whole grain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(svgs/1,000 kcal)</td>
<td>&lt;0.3</td>
<td>0.3-&lt;0.5</td>
<td>0.5-&lt;0.7</td>
<td>0.7-&lt;1.0</td>
<td>≥1.0</td>
<td></td>
</tr>
<tr>
<td>Cases/ person years</td>
<td>39/670,289</td>
<td>34/675,902</td>
<td>41/677,448</td>
<td>29/677,897</td>
<td>22/678,431</td>
<td></td>
</tr>
<tr>
<td>Relative Risk</td>
<td>1.0</td>
<td>0.86</td>
<td>1.03</td>
<td>0.73</td>
<td>0.59</td>
<td>p&lt;0.06</td>
</tr>
<tr>
<td>Fiber from grains</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(g/day)</td>
<td>&lt;3.7</td>
<td>3.7-&lt;5</td>
<td>5-&lt;6.4</td>
<td>6.4-&lt;8.4</td>
<td>≥8.4</td>
<td></td>
</tr>
<tr>
<td>Cases/ person years</td>
<td>34/675,077</td>
<td>41/677,599</td>
<td>32/676,861</td>
<td>37/675,221</td>
<td>21/675,209</td>
<td></td>
</tr>
<tr>
<td>Relative Risk</td>
<td>1.0</td>
<td>1.10</td>
<td>0.81</td>
<td>0.91</td>
<td>0.51</td>
<td>p&lt;0.01</td>
</tr>
</tbody>
</table>
Whole Grains & Cancer: Potential Mechanisms

Gastrointestinal

- Carbohydrate fermentation
- Decreased transit time and increased fecal bulk
- Antioxidant activity
- Glucose/insulin response
Whole Grains & Total Mortality: Epidemiological Studies

Harvard Male Health Professionals (86,000)

1 or more serving/day of whole grain cereal (compared to none)

Mortality
RR 0.80

Iowa Women’s Health Study (34,333)

3 or more servings/day of whole grain foods

Hazard
RR 0.86

Whole Grain Intake and Weight Loss: Study Design

50 men and women with metabolic syndrome

Age 20-65

All grains from refined grains (12 weeks)

Assess weight loss and cardiovascular risk factors

All grains from whole grains (4-7 servings/d) (12 weeks)

Inclusion Criteria

1. Men and women with a BMI $\geq 30$ kg/m$^2$
2. Have at least 3 ATP III criteria for metabolic syndrome:
   - Abdominal obesity (elevated waist circumference)
     - Men $\geq 102$ cm; Women $\geq 88$ cm
   - Raised triglycerides ($\geq 150$ mg/dL)
   - Reduced HDL cholesterol
     - Men $< 40$ mg/dL; Women $< 50$ mg/dL
   - Raised blood pressure ($\geq 130/85$ mmHg)
   - Elevated plasma glucose ($\geq 100$ mg/dL)
3. Not taking any medications known to affect glucose tolerance, lipids, or reproductive hormones
Endpoints

• Weight loss * Primary Endpoint
• Lipids and Lipoproteins
  – Cholesterol, HDL, LDL, VLDL, triglycerides
• Inflammation
  – C-reactive Protein, IL-1, IL-6, TNF-α
• Waist Circumference & Abdominal Adiposity
• Glucose Tolerance
  – Glucose & insulin response to an OGGT
• Diet Satisfaction
## Baseline Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Whole Grain</th>
<th>Refined Grain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>45 ± 8</td>
<td>47 ± 10</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>36 ± 4</td>
<td>36 ± 5</td>
</tr>
<tr>
<td>Waist Circ (cm)</td>
<td>117 ± 12</td>
<td>118 ± 10</td>
</tr>
<tr>
<td>LDL (mg/dL)</td>
<td>119 ± 39</td>
<td>115 ± 20</td>
</tr>
<tr>
<td>HDL (mg/dL)</td>
<td>41 ± 9.0</td>
<td>41 ± 8.0</td>
</tr>
<tr>
<td>Tgl (mg/dL)</td>
<td>146 ± 63</td>
<td>162 ± 65</td>
</tr>
<tr>
<td>Glucose (mg/dL)</td>
<td>96 ± 8</td>
<td>96 ± 6</td>
</tr>
<tr>
<td>Insulin (µU/mL)</td>
<td>15 ± 8</td>
<td>14 ± 7</td>
</tr>
<tr>
<td>Systolic BP (mmHg)</td>
<td>123 ± 9</td>
<td>130 ± 13 *</td>
</tr>
<tr>
<td>Diastolic BP (mmHg)</td>
<td>82 ± 8</td>
<td>83 ± 8</td>
</tr>
</tbody>
</table>

Values are Mean ± SD. * P < 0.05 difference between groups
Both groups complied with whole grain recommendations

* $P < 0.001$ difference between groups. Values are mean ± SE.
Sources of whole grain foods in the whole grain group

- Bread and Rolls
- Ready to Eat Cereal
- Salty Snacks
- Grains & flours
- Pasta
- Snack bars

Week
Body weight decreased in both groups

No significant difference between groups in weight loss at any time point
Improvements in other biometric measurements

- Significant treatment effects
  - Systolic BP (mmHg)
  - Diastolic BP (mmHg)
  - Waist Circ (cm)
  - Abdominal body fat (%)
  - Body Fat (%)

Change

- Whole Grain
- Refined Grain

P-values:
- P=0.06
- P<0.001
- P<0.03
C-reactive protein decreased in the whole grain group only (by 38% vs baseline)

* $P = 0.007$ different between groups. Values are mean ± SE.
No significant difference between groups in lipids and lipoproteins

- Total Chol
- LDL-C
- HDL-C
- Triglycerides
- TC:HDL

* $P<0.05$, different from baseline. Values are mean ± SE.
The “Whole” Truth

- Consuming whole grains was associated with improved diet quality

- No significant difference in weight loss between a whole grain and refined grain diet

- Greater reduction in C-reactive protein in participants in the whole grain group

- Greater reduction in percentage body fat in the abdominal region in the whole grain group

- No significant differences between groups in change in lipids and lipoproteins or glucose tolerance
Benefits of Whole Grains Go Beyond Fiber

**Bran**
“Outer shell” protects seed
- Fiber
- B Vitamins
- Trace Minerals
- Phytochemicals

**Germ**
Nutrient storehouse
- B Vitamins
- Vitamin E
- Trace Minerals
- Phytochemicals
- Antioxidants
- Lipids
- Healthy Fats

**Aleurone**
Layer of cells adjacent to endosperm
- Protein
- Enzymes
- Fiber
- Phytochemicals

**Endosperm**
Provides energy
- Carbohydrate
- Protein
- Some B Vitamins
Whole Grains Have Benefits Beyond Fiber


Diagram:
- Whole Grain
- Traditional Nutrients, Vitamins, and Minerals
- Fiber
- Resistant Starch
- Lignan
- Antioxidants
- Plant Stanols and Sterols
- Phytate
- Inulin and Fructooligosaccharides

Phytonutrients

- Small but powerful disease fighters found naturally in plant and plant-based foods.
- Whole grains contain significant amounts of the phytonutrients lignan, phytic acid, and phytosterols.
- Aim to get a variety of whole grains in your diet—that way you’re more likely to get all of the phytonutrients your body needs!
Whole Grain Recommendations

Recommendations

• The 2005 Dietary Guidelines recommends 3 or more servings of whole grains per day

• DGAC 2010 recommends increasing consumption of fiber-rich whole grains

• Healthy People 2010 objectives aim for 3 servings/day

• American Diabetes Association, 2011 recommends foods containing whole grains (1/2 of grain intake)

• AHA, 2020 Goals - Fiber-rich whole grains (1.1 g of fiber per 10 g of carbohydrate): three 1-oz-equivalent servings per day
Average whole grain intake is less than 1 serving/day

NHANES 1999-2002

9/10 Americans not eating 3 sv/d whole grains
Dietary Intakes Compared to Recommended Intakes

Eat more of these:
- Whole grains: 15% vs. 59%
- Vegetables: 42% vs. 61%
- Fruits: 52% vs. 61%
- Milk: 42% vs. 75%
- Oils: 56% vs. 75%
- Fiber: 56% vs. 75%
- Potassium: 40% vs. 75%
- Vitamin D: 40% vs. 75%
- Calcium: 40% vs. 75%

Eat less of these:
- Calories from SoFAS: 280% vs. 242%
- Added sugars: 281% vs. 242%
- Solid fats: 200% vs. 242%
- Refined grains: 200% vs. 242%
- Sodium: 158% vs. 229%
- Saturated fat: 158% vs. 229%

Intake as percent of goal

Conclusions

- Scientific evidence supporting the health benefits of whole grains continues to grow.
- Scientific support of the health benefits of whole grains is **strong and consistent**, based on the totality of the evidence.
- Health benefits of whole grains are attributed to **all parts** of the whole grain - bran, germ, and endosperm.
Consume Fiber-Rich Whole Grains!