

***Health effects of whole
grain: beyond coronary
heart disease and
diabetes***

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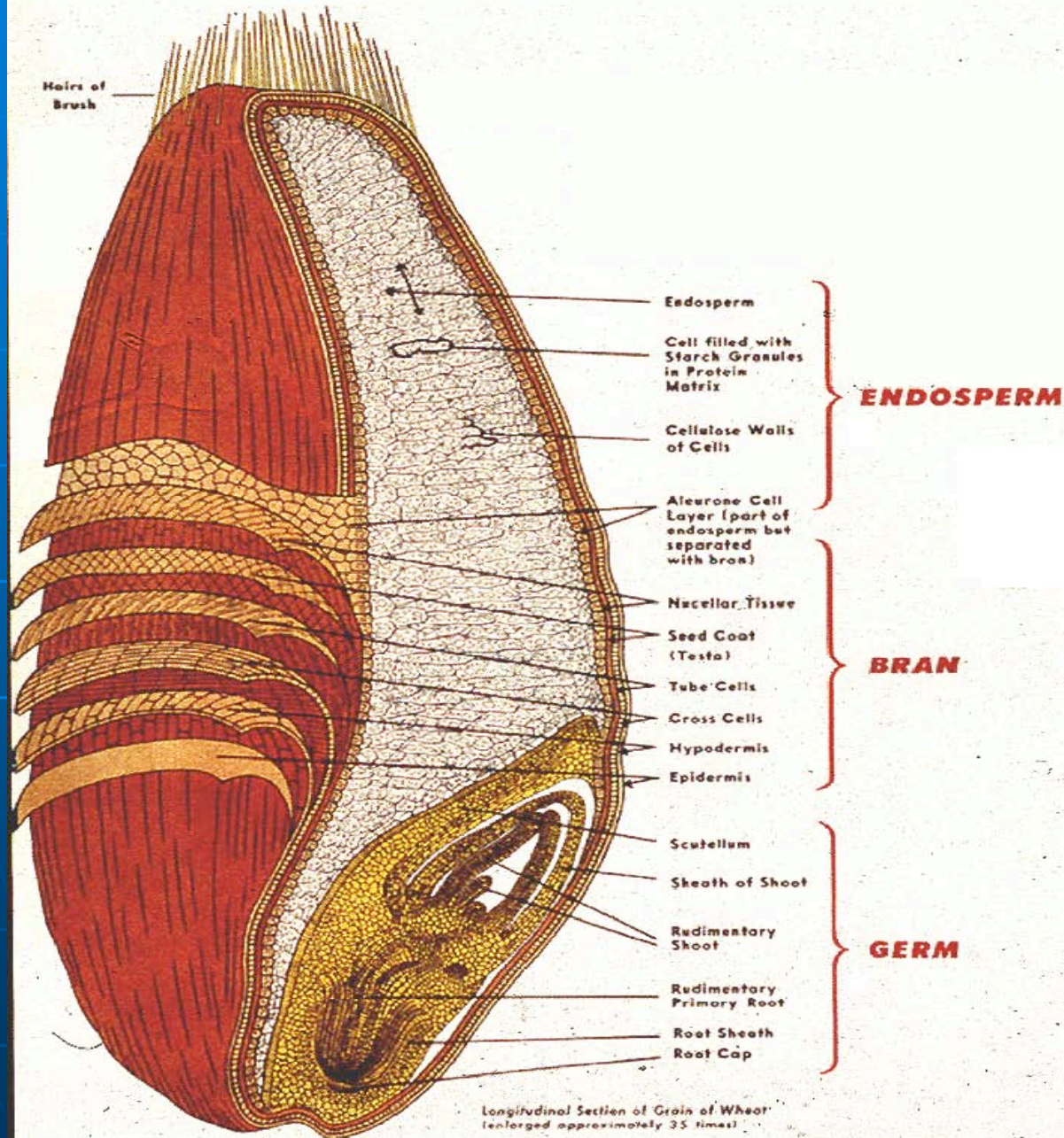
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Oldways Whole Grain Council

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a Kernel of Wheat



Bran and Germ:

17% of weight

80% of fiber

Few calories

Has most of the biologically active compounds in the grain, lost in refining

Whole grain and cereal fiber are related but different

Cereal fiber per 100 g of whole grain

Rye **14.6 g**

Wheat **12 g**

Oats **10.6 g**

Corn **7.3 g**

Brown rice **3.5 g**

Refined grain, all species **<2 g**

Botanical function

Endosperm:

Nutrients: starch-filled, poor-quality protein

Botanical function: supply energy to the seedling prior to roots that allow self-sustenance

Germ:

Nutrients: fatty acids, antioxidant compounds

Botanical function: plant embryo

Botanical function

Bran:

Nutrients: *most of the fiber, many B-vitamins, minerals, major groups of antioxidants including several cinnamic acids, flavonoids, and tocopherols, as well as unidentified compounds.*

Bran and germ:

Botanical function: *signaling activation of biologic processes, preventing adverse oxidation, defense of the seedling against microorganisms.*

Form of Processing

Nutritional significance of processing?

- Crushing and pulverizing to a fine flour may not cause much damage, given the microscopic size of cells.***
- Cell disruption may increase digestibility.***
- Intactness does improve the glycemic index (lower glucose response soon after eating, importance debated)***

History

- *Early 1800s: Sylvester Graham*
- *1940s-1970s: Walker, Burkitt, Cleave, and Trowell*
- *1977: Morris JN, Marr JW, Clayton DG: Diet and heart: a postscript. BMJ.*
 - *337 bankers and busmen, 7 days of weighed food records, followed through 1976*
 - *CHD by tertile of cereal fiber: 25, 10, and 5*
 - *Cereal fiber tertiles were almost coincident with brown bread and strongly graded with breakfast cereal tertiles*

Prospective Studies of Whole Grain Foods: Cardiovascular

Jacobs and Gallaher review, 2004, 13 studies plus 2 more recent:

Mostly middle-aged at year 0 (two studies restricted to age ≥ 60)

*One study in Norway, 2 in Finland, 1 in England
>520,000 men and women, followed 6-19 years*

Over 10,000 heart attacks, strokes, other cardiovascular disease, fatal or nonfatal

Relative risk for high vs. low whole grain intake:

0.50 – 0.86

7 studies of cereal fiber agreed

Prospective Studies of Whole Grain Foods: Progression of Atherosclerosis

- ***Estrogen Replacement and Atherosclerosis trial***
 - *229 postmenopausal women*
 - *3 yr decline in minimum coronary artery diameter*
 - *-0.10 mm for 14 sv/wk vs -0.06 mm for 3 sv/wk*
 - *P = .04*
 - *Erkkila AT et al. Am Heart J. 2005*
- ***Los Angeles Atherosclerosis Study***
 - *573 men and women CVD free aged 40-60, repeated carotid wall thickness*
 - *Progression of wall thickness less in high vs. low fiber diet by about 18 vs 36 μ m/3 yr*
 - *Wu, Dwyer et al, AJCN. 2003*

Prospective Studies of Whole Grain Foods: Congestive Heart Failure

- ***Breakfast cereal intake and incident HF, 21 376 participants of the Physicians' Health Study I.***
 - ***19.6 years follow-up, 1018 incident cases of HF occurred.***
 - ***0 vs 7 or more servings/week: , hazard ratios 0.71 (P<.001***
 - ***Association limited to whole grain cereals***
- ***Djoussé, Gaziano Arch Int Med 2007***

Prospective Studies of Whole Grain Foods: Diabetes Type 2

4 studies of whole grain foods

All middle-aged at year 0

1 in Finland

158,723 men and women, 6-12 years

4373 incident type 2 diabetes

Relative risk for high vs. low whole grain intake:

0.62 – 0.79

Studies of Whole Grain Foods: Noncardiovascular, noncancer, inflammatory death

- **Iowa Women's Health Study,**
 - 27312 women free of CVD, cancer, diabetes, known inflammatory condition, 55-69 in 1986
 - followed 17 yr
- **1071 inflammatory deaths:**
 - neither cancer nor CVD,
 - causes of death selected for probable important role of inflammation, oxidative stress, and infection
 - respiratory (n=569)
 - nervous system (n=241)
 - infectious, endocrine, metabolic, digestive, musculoskeletal, genitourinary

Studies of Whole Grain Foods: Noncardiovascular, noncancer, inflammatory death

■ **Iowa Women's Health Study**

- **Graded 27% risk reduction in cardiovascular disease death as whole grain food increased**

- **1071 inflammatory deaths: Risk 35% lower in habitual whole grain eaters**

Jacobs et al, Am J Clin Nutr, 2007

Studies of Whole Grain Foods: Lung Disease

■ *MORGEN study*

- *13,651 men and women aged 20-59 years cross-sectional between 1994 and 1997*
- *Whole grain eaters had higher lung capacity, less COPD*
 - *Tabak et al. Clin Exp Allergy. 2001*

■ *Male Health Professionals*

- *42,917, 40-75 y in 1986 no asthma or COPD*
- *111 incident COPD*
- *50% reduction in risk for high prudent diet score (whole grain, fruit , vegetable, fish increased)*
- *Parallel unpublished finding mentioned in Nurses*
 - *Varosso et al. Thorax 2007*

Studies of Whole Grain Foods: Inflammatory Factors

- **Nurses and Health Professionals, n=938 healthy men and women, cross-sectionally whole grain eaters had lower homocysteine, insulin, C-peptide, leptin, lipids; not inflammatory markers**
 - **Jensen et al. Am J Clin Nutr. 2006;83(2):275-83**
- **Nurses, n=902, whole grain eating diabetic women had reduced CRP and tumor necrosis factor-alpha receptor 2**
 - **Qi et al. Diabetes Care. 2006;29(2):207-11**
- **Several other studies agree**
 - **McKeown, Lutsey, Esposito (randomized Mediterranean diet) inflammatory factors**

Studies of Whole Grain Foods: Appendicitis

- **135 children (0-18 yr) with appendicitis, 212 comparison children**
 - **>median fiber intake 30% lower risk**
>median whole grain foods 50% lower,
especially aged 7-18
 - **Brender Am J Pub Health 1985**
- **203 cases (2-14 yr), 1922 controls**
 - **diet fiber 20.4 vs 17.4 g/d in controls vs cases (body weight and height not different)**
 - **Adamidis Int J Food Sci Nutr 2000**
- **Neither study adjusted for other behaviors**

Studies of Whole Grain Foods: Gallstones

91 cholelithiasis, 86 controls

- **Cholelithiasis cases less crude fiber, especially from bread and bakery products**
- **Smith and Gee Am J Clin Nutr 1979**

■1810 symptomatic gall stones in 44525 health professional men (12 yr followup)

- **High refined carbohydrate, starch, simple sugars elevated risk**
- **Tsai Gut 2005**

Studies of Whole Grain Foods: Duodenal Ulcer

■ Randomized trial

- 21 chronic duodenal ulcer patients unrefined wheat diet
- 21 usual diet in a rice-eating area
- After 5 years only 14% of the first group had had relapses compared with 81% of controls

- 30 other patients in another area with a more varied rice diet observed for 5 years: 80% 5-year relapse rate.
- Malhotra Postgraduate Medical J 1978

Studies of Whole Grain Foods: Periodontitis

■ **Periodontitis:**

- **1897 professionally diagnosed periodontitis in 21 yr followup among 34160 male health professionals aged 40-75**

- **Free of CVD, diabetes, periodontitis at baseline**

- **Graded risk reduction with increasing whole grain intake, 23% reduction in risk**

- **Merchant, Joshipura Am J Clin Nutr 2006**

■ **Desvarieux, Jacobs et al, Circulation 2005: periodontal disease is related to CVD**

Studies of Whole Grain Foods: Erectile Dysfunction

■ **2 year randomized study of Mediterranean diet vs control in men with ED and metabolic syndrome**

- **Mediterranean diet ate more fruits, vegetables, nuts, whole grain, and olive oil**
- **Endothelial function and CRP improved**
- **37% (13/35) vs 7% (2/30) had good erectile function after 2 years**
- **Esposito Int J Impot Res. 2006**

Why are whole grain foods healthful?

- Long term effects may differ from the effects over only a few weeks
 - **Food Synergy** – the proposition that the different natural components in food act jointly for the health of the eater, just as they act to keep the organism eaten alive
 - The package of **phytochemicals** in nutrient rich plants probably acts synergistically
 - Food synergy may be even stronger in **food patterns**, such as the “**prudent diet**”

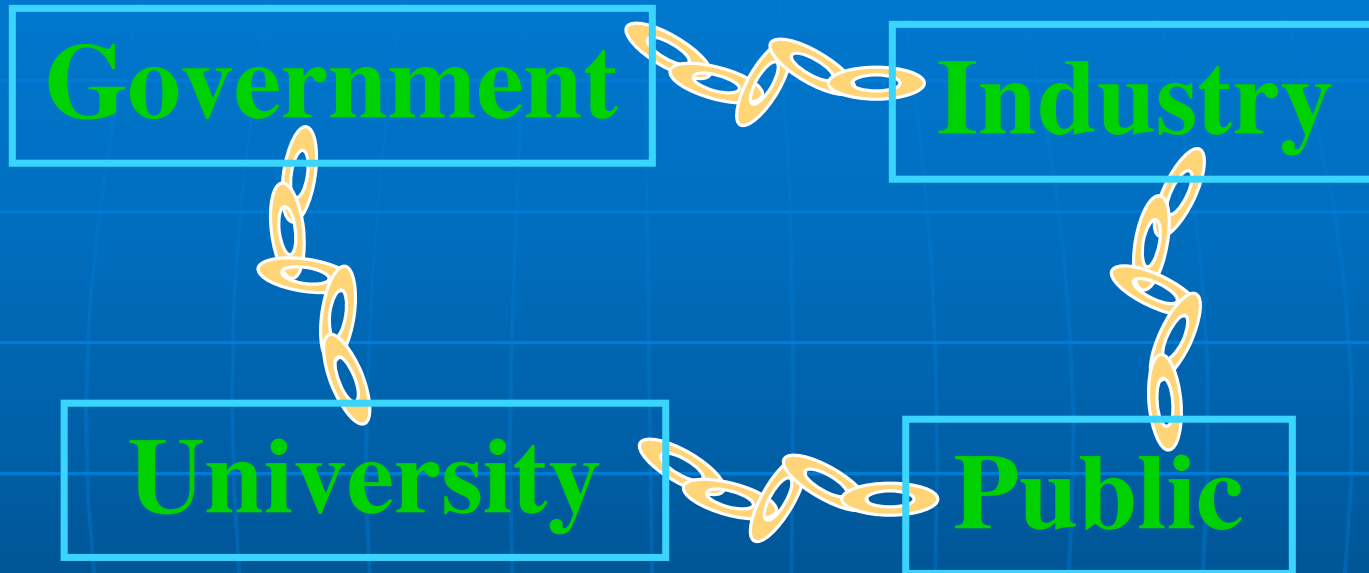
Why are whole grain foods healthful?

- **The concepts of Food Synergy and the potential power of the package of naturally occurring phytochemicals in nutrient rich plants imply important novel constituents**
- **Polyphenolic compounds and particularly flavonoids often mentioned**
 - **Studies so far are tantalizing, do not predict disease as clearly as whole grains and prudent diet patterns**

Why are whole grain foods healthful?

- **Whole grains are seeds which must have certain broad characteristics to support the new sprout**
- **The analogy with seeds leads to tree nuts, soy, berries, chocolate, and coffee, all of which have been related to reduced risk in prospective epidemiologic studies; and spices which have some of the most obvious polyphenols, at least in terms of sensory qualities**

Model of Culture Bounded Change



No one cultural sector can be very far out of step from the others; each can facilitate change in the others