

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

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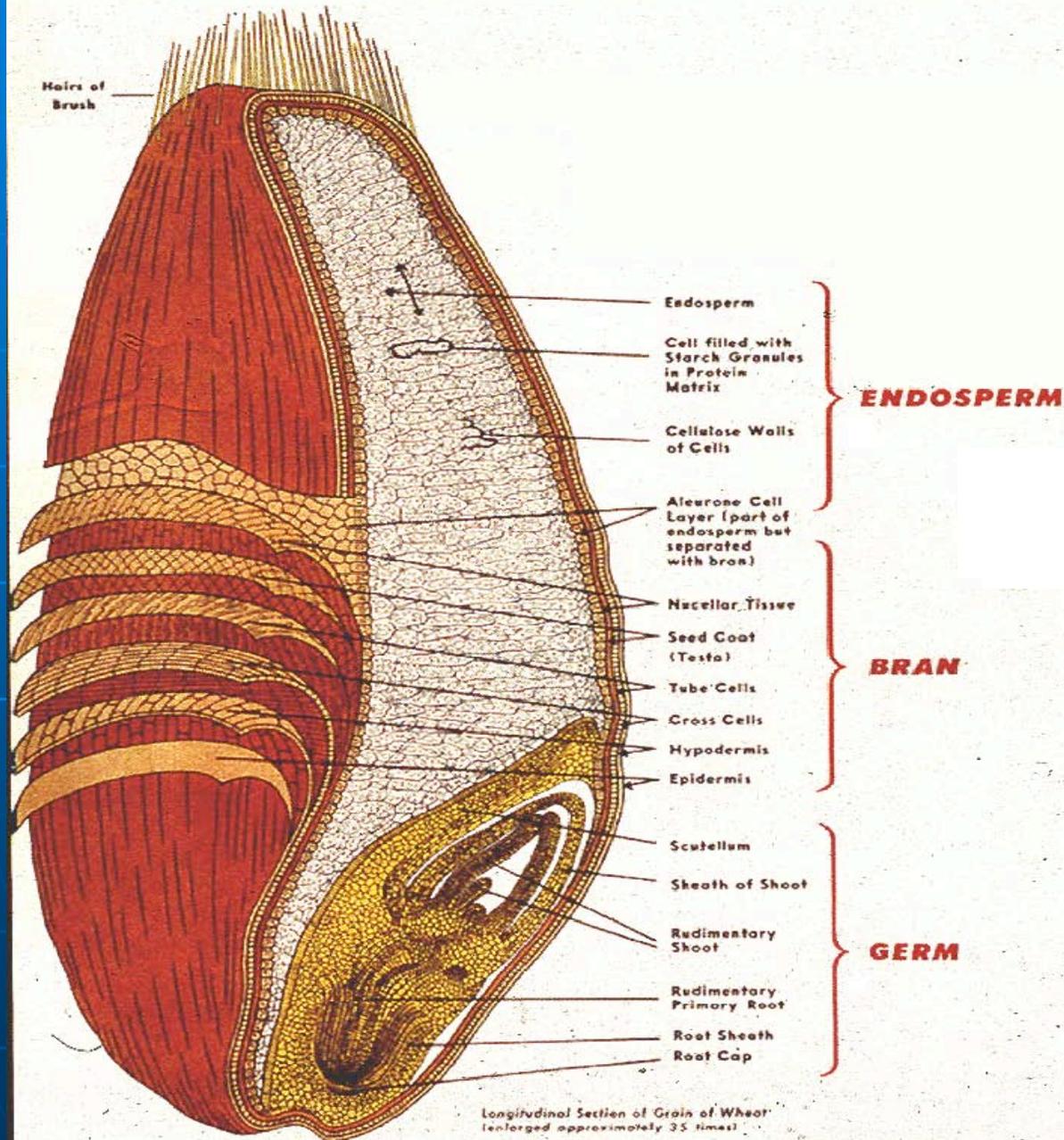
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***Kansas City, MO***

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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  $\geq 60$ )*

*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  $\mu$ 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**”

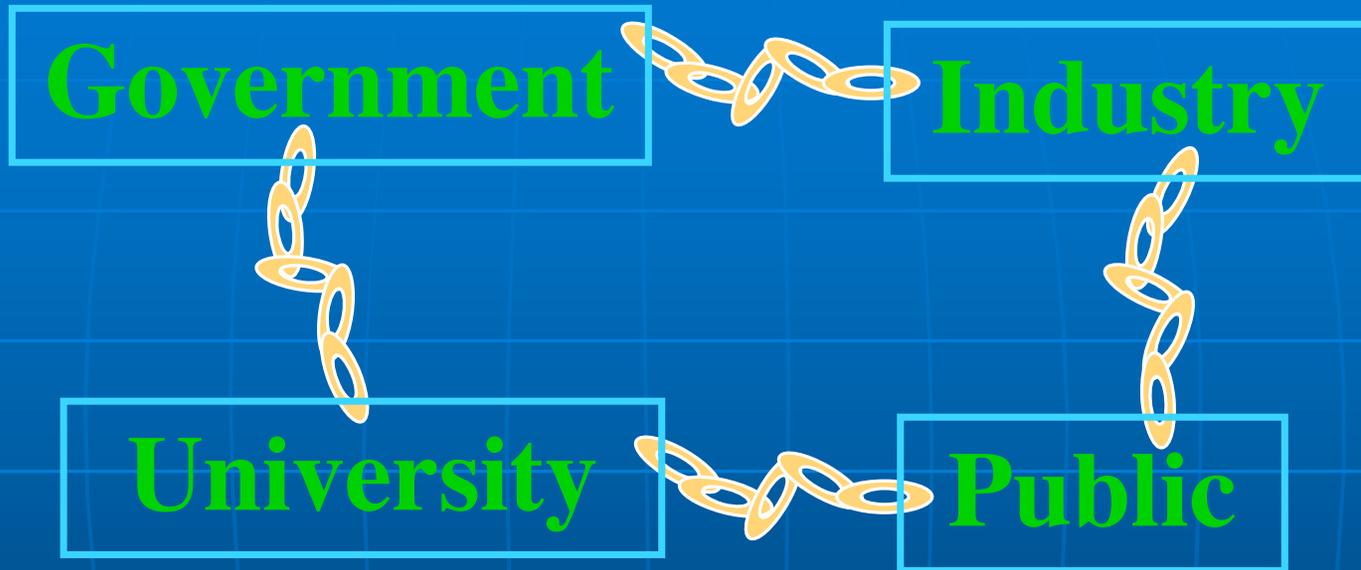
# Why are whole grain foods healthful?

- **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**