Whole Grains and Health

Get the recent Whole Grain Story

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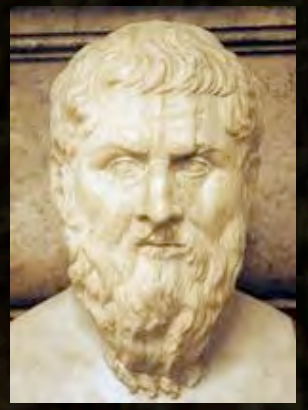
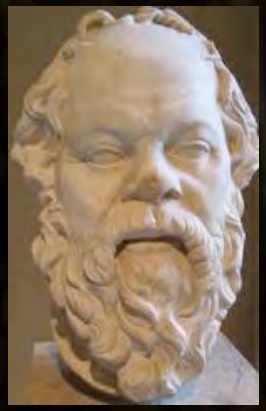
Whole vs Refined Grains:
Debated by the Great Philosophers

- 400 B.C. - Plato advocated good health and longevity through eating locally grown whole grain breads
- Socrates likened Plato's whole grain bread to "pig-food"!
- Plato lived longer, but Socrates' encounter with Hemlock may have influenced that outcome.





Galen

- Food that excites the bowels to evacuate and food that prevents them.
- White bread is the stickiest and slowest to pass.
- Brown bread good for the bowels.

Goals for Talk

- An old debate re-examined
- Whole Grains (WG) and Health
  - New studies, reviews
  - Comparison or interventional and epidemiological (observational) data
  - Confounding
  - Multiple mechanisms/ endpoints

Goals for Talk

- Whole grain definitions – update
  - Not all whole grains are the same
  - Processing affects whole grains
- What do we know; what can we say

Whole Grain – Parts and Nutrients

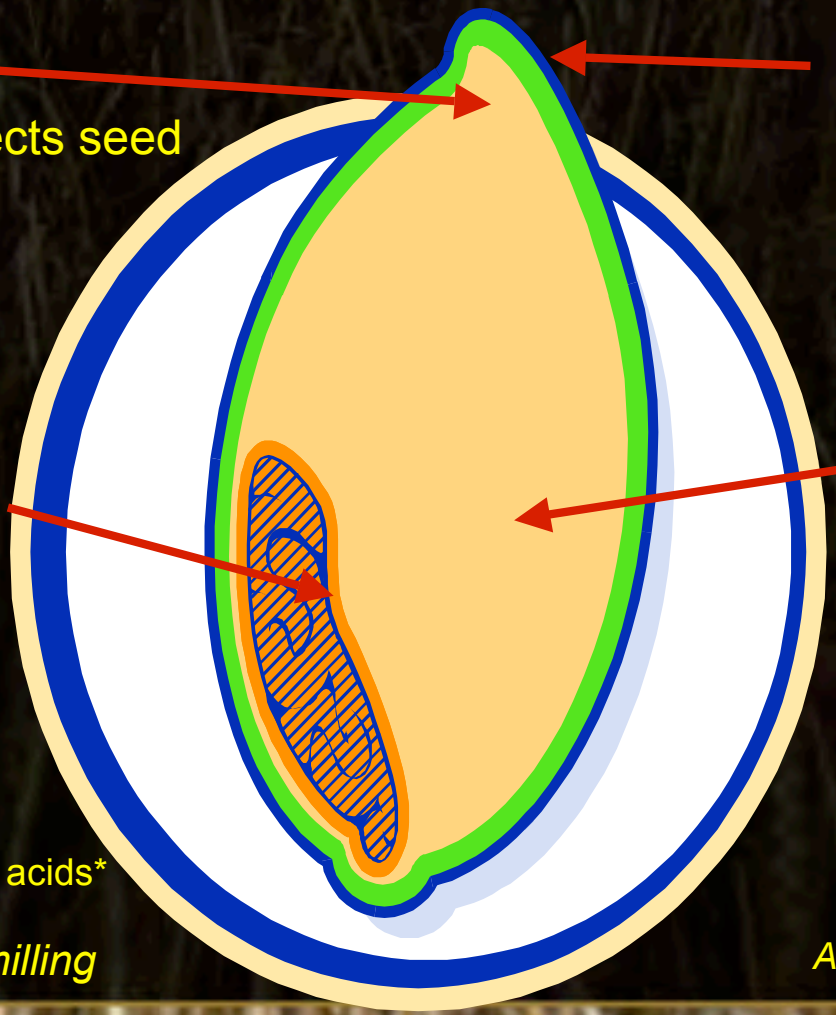
14% Bran

"Outer shell" protects seed

- Fiber
- B Vitamins
- Trace Minerals

Aleurone

Nutrient-rich layer under the bran



2-3% Germ

Nourishment for the seed

- B Vitamins
- Vitamin E
- Trace Minerals
- Phytochemicals
- Polyunsaturated fatty acids*

83% Endosperm

Provides energy

- Carbohydrate
- Protein
- Some B Vitamins

** Reason for milling*

Adapted from General Mills

WG Intake Assoc. with Lower Risk of Many Chronic Diseases

- Observational studies have shown a strong link
  - Hypertension
  - Weight & Obesity
  - Diabetes / Metabolic Syndrome
  - Cardiovascular disease
  - Some Cancers
  - Total Mortality

WG & RR of Hypertension - Epi

28 926 female US health professionals – quintiles of intake

Servings of WG/ day	<1/2	½-1	1-2	2-4	>4
RR	1	0.93	0.93	0.92	0.77

Wang et al . Am J Clin Nutr. 2007; 86:472-9.

WG Hypertension: Intervention
Effects of Different Grains

16 subjects; 5 weeks, 20% of E

1. Whole wheat/ brown rice
2. Barley
3. Half wheat/ rice and half barley diets

- ↓Systolic BP - diets 1, 3
- ↓Diastolic BP - diets 1,2,3
- earlier studies with oats

Behall et al. J Am Diet Assoc. 2006;106:1445-9.

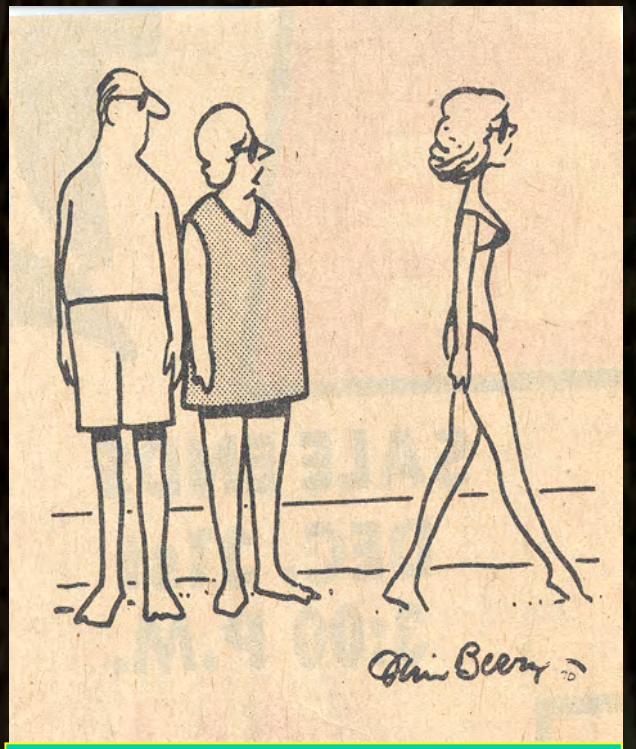
Hypertension

- Fewer studies in this area
- All in same direction
  - both interventions and epi

WG and Weight: Epi

- "Weight gain was positively related to the intake of refined-grain foods, which indicated the importance of distinguishing whole-grain products from refined-grain products to aid in weight control." **88,000 nurses**
- Regular consumption of products (25% whole grain) associated with less body weight gain 17,881 US male health professionals 8 yrs

Liu et al Am J Clin Nutr. 2003 78:920-7; Bazzano et al Obes Res. 2005;13:1952-60; Koh-Banerjee et al. Am J Clin Nutr. 2004;80:1237-45.



That reminds me "Where's my rye crisp?"

WG and Body Weight: New Epi

- NHANES 1999-2000 - USDA Pyramid Servings Database
  Women 19 years of age and older (n = 2,092)
- Women who consume ≤ 1 WG sv
  - Lower mean waist circumference
  - Lower mean BMI

Good et al J Am Coll Nutr. 2008; 27:80-7

WG and Weight - Epi

Comprehensive review showed strong evidence

- Diets high in whole grains associated w/
  - Lower BMI
  - Smaller waist circumference
  - Reduced risk of being overweight

Williams et al Nutr Rev. 2008; 66:171-82

Whole Grains and Weight - Epi

Comprehensive review showed strong evidence

- WG diets can help reduce weight gain
  - significant weight loss is achievable with energy-controlled diets that are high in cereals
    - » No evidence that Low-CHO diets that restrict cereal offer long-term advantages for sustained weight loss

Williams et al Nutr Rev. 2008; 66:171-82; Harland Newcastle AACC 2009

WG and Body Weight in Teens - Epi

•215 teens Dortmund Nutritional and Anthropometric Longitudinally Designed (DONALD) Study

•Neither Whole grain intake nor GI, GL, fiber intake by teens were associated with

- •concurrent changes in %BF
- • BMI

Cheng et al Am J Epidemiol. 2009;169:667-77

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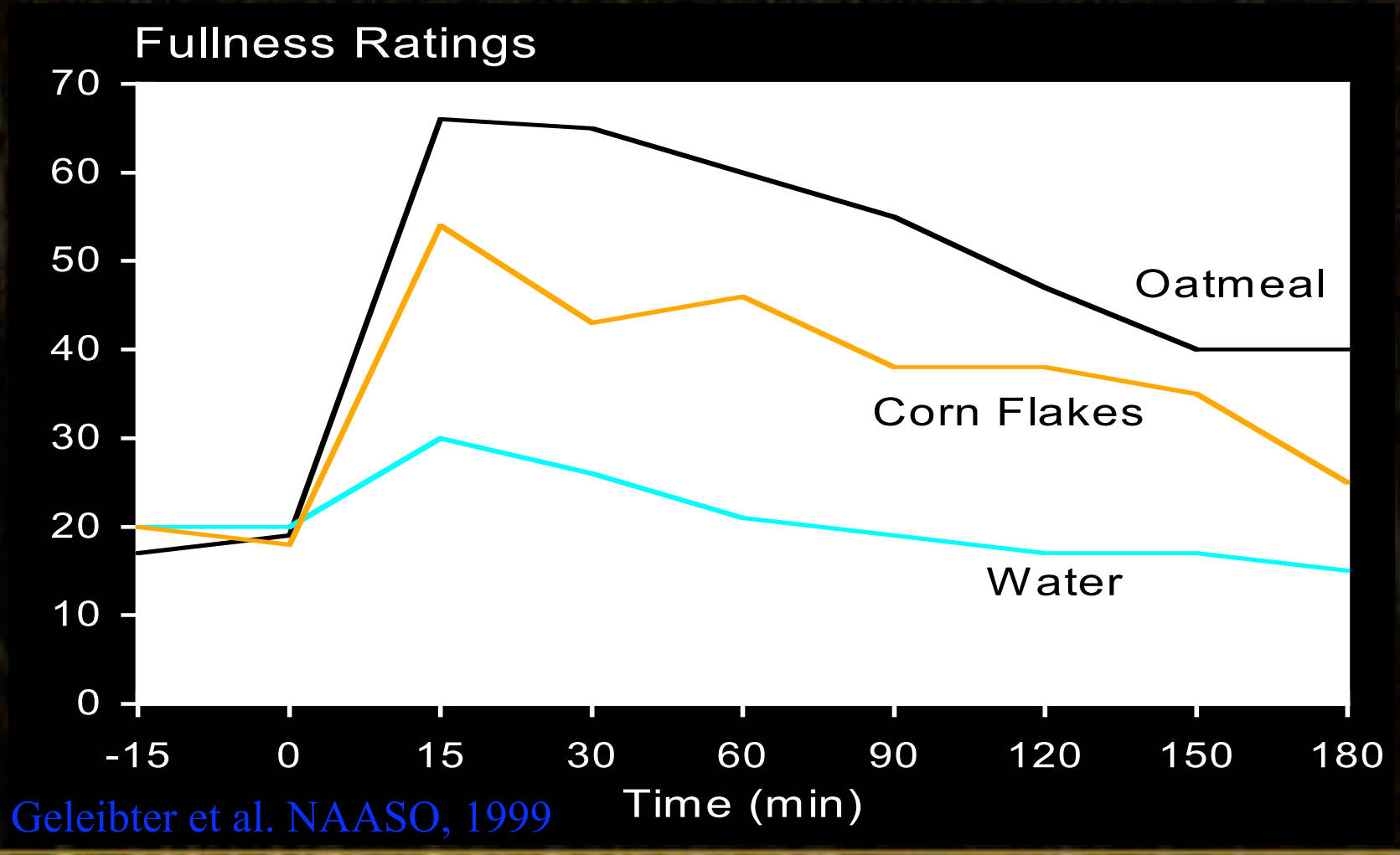
Wg and Weight

- Mostly positive
  - Is this due to confounding?
  - Study with teens no relationship
- Need clinical trials

WG and Satiety – Oats vs Refined Corn



Geleibter et al. NAASO, 1999

WG and Satiety –Rye vs White

n=22 adults; randomized, crossover design; Appetite visual analogue scales

- WG rye porridge breakfast and WG pasta lunch vs iso-energetic wheat bread breakfast and pasta lunch
- Whole grain vs refined
  - prolonged satiety
  - lowered hunger and desire to eat - up to 8 h
  - **no significant effect on ad libitum energy intake in the evening** and breakfast meal on day 2.
  - Is increased satiety important if intake does not change?

Isaksson et al Food Nutr Res. 2008;52

WG and Glycemia – Another variable

- ‘Diets with WG foods increase postprandial glycaemia and insulinemia and may compromise weight control via mechanisms relating to appetite stimulation, fuel partitioning and metabolic rate.’

Brand-Miller Asia Pac J Clin Nutr. 2008;17 Suppl 1:16-9.

Whole Grains and Metabolic Syndrome – Epi data

- Mean intake 0.5 sv/d; Multiethnic group n=5496
- WG intake was inversely associated
  - obesity
  - insulin resistance
  - Inflammation
  - elevated fasting glucose
  - newly diagnosed diabetes

Lutsey et al. Br J Nutr. 2007 ;98:397-405.

WG and Metabolic Syndrome – Intervention with Reduced E

- 31 Obese subjects – both reduced E
- WG w/ reduced starch / reduced calorie
  - Vs nutrient dense meal replacement
- Body weight ↓more with WG
  TG
- Fasting blood glucose & Insulin resistance improved more with WG

Rave et al. Br J Nutr. 2007: 1-8

WG and Met Syndrome Markers: Intervention

- Overweight Swedish women (22) men (8)
- 6 sv WG vs refined - 6 wk
- No effect
  - Peripheral insulin sensitivity
  - Markers of inflammation
  - Markers of lipid peroxidation

Andersson et al J Nutr. 2007;137:1401-7

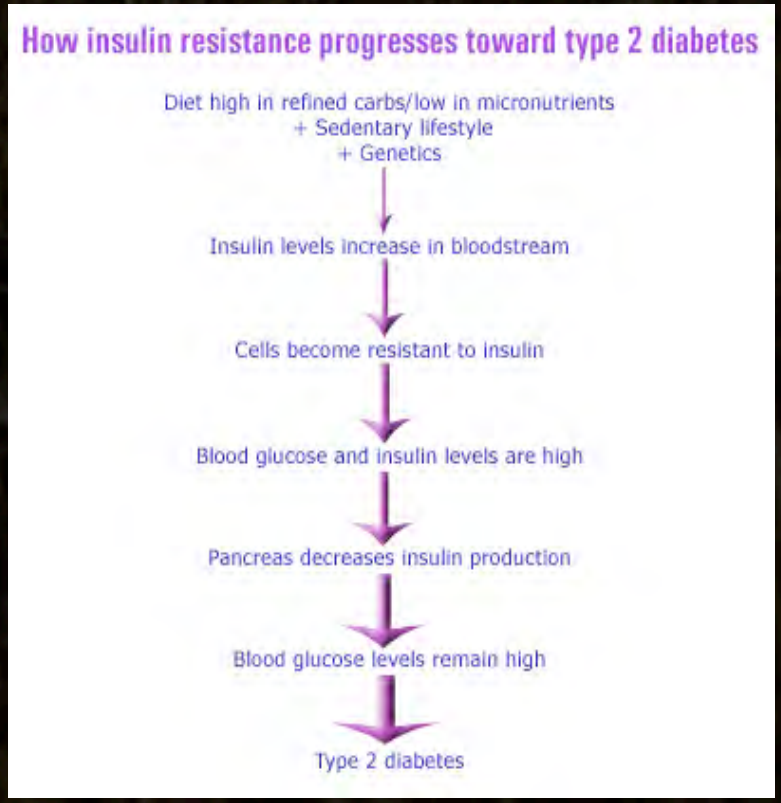
WG and Metabolic Syndrome – Intervention/ Mechanism

- N=47; 12 weeks; abdominal subcutaneous adipose tissue
- rye-pasta diet - low postprandial insulin response
  - down-regulated 71 genes including genes linked to insulin signaling and apoptosis
  - Improved insulinogenic index
- oat-wheat-potato diet - high postprandial insulin response
  - Up-regulated 62 genes related to stress, cytokine-chemokine-mediated immunity, and the interleukin pathway

Kallio et al. Am J Clin Nutr. 2007;85:1417-27

WG and Metabolic Syndrome

- Epi data show benefits
- 6 wk intervention ns
- Many outcomes
- Many mechanisms



http://www.womentowomen.com

Whole Grain: T2DM epi data

Iowa Women's Health Study
N=35,000

21% ⬇risk

Nurses' Health Study
N= 88,000

27% ⬇ risk

~ 3 servings of whole grains daily

Meyer, et al., *AJCN*, Apr. 2000; Liu, et al., *AJP*, Sept. 2000; Montonen, et al., AJCN, 2003

WG and Diabetes – EPI and Genetics

- case-cohort study of 2318 randomised individuals and 724 T2 DM (EPIC)
- Transcription factor-7-like 2 encoding gene (TCF7L2) promotes insulin secretory defect assoc T2DM
  - WG intake - inversely associated with diabetes risk among rs7903146 CC homozygote carriers
  - The TCF7L2 rs7903146 T-allele assoc. T2DM - if present, modified inverse association between whole-grain intake and diabetes risk

Fisher Br J Nutr. 2009 ;101(4):478-81

Cochrane Review T2DM

Effects WG foods and cereal fiber & T2DM

- 11 cohort studies - 5 yrs vs 1 RCT 6 wks
  - 4/11 cereal fiber intake, 3/11 WG intake; 2/11 both
- Consistently showed a reduced risk
  - WG foods ↓ 27% - 30%
  - Cereal fiber ↓ 28% - 37%
  - Different populations, diets → consistent

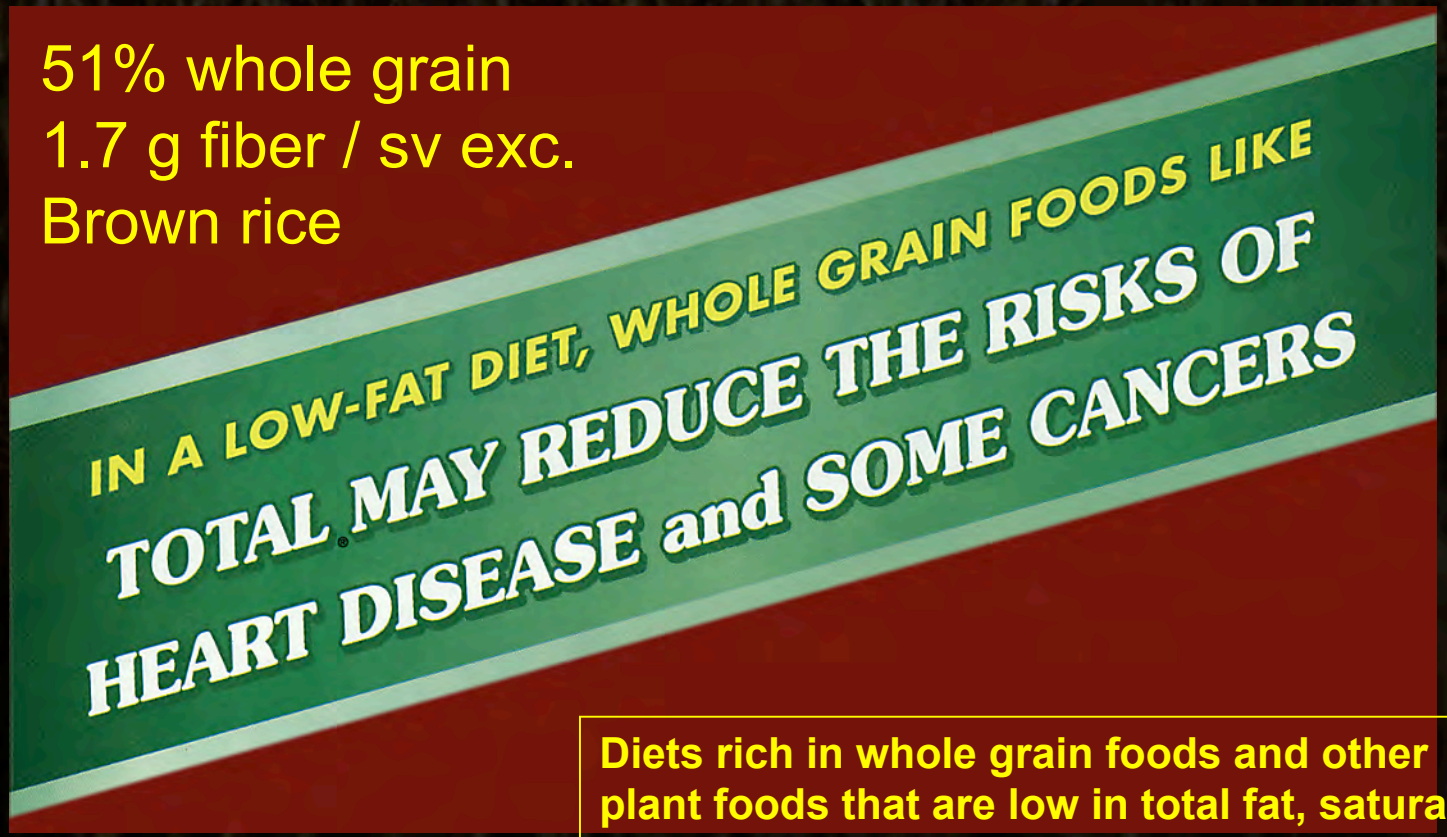
Cochrane Review T2DM

"The evidence from only prospective cohort trials is considered to be too weak to be able to draw a definite conclusion about the preventive effect of whole grain foods on the development of T2DM. Properly designed long-term RCT…"

Priebe et al Cochrane Database Syst Rev. 2008 Jan 23;(1):CD006061.

Whole Grain and Heart Disease

51% whole grain
1.7 g fiber / sv exc.
Brown rice



Diets rich in whole grain foods and other plant foods that are low in total fat, saturated fat, and cholesterol may reduce the risks of heart disease and certain cancers.

Whole Grains and CVD

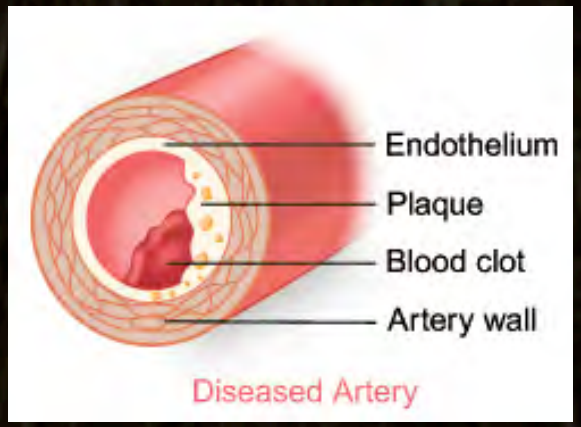
IRAS study n=1178; ultrasound

- Median baseline intake 0.8 sv/d

- High WG eaters

⑩↓ carotid intimal thickness

» significant after adjusting for adiposity, insulin resistance, other dietary components



Mellen et al AJCN. 2007;85:1495-502

Whole Grains and Coronary Disease Meta-analysis

- 2.5 vs 0.2 sv/d
  - 21% lower risk of CVD events [OR 0.79]
- "Consistent, inverse association between dietary whole grains and incident cardiovascular disease in epidemiological cohort studies."

Mellen et al Nutr Metab Cardiovasc Dis 2007;85:1495-502.

WG and Coronary Disease

- LSRO study Falk et al 2008
- If use a strict whole grain definition and exclude any studies that also used bran and germ
- NO Relationship
  - Relationship only significant if it uses the broader definition of whole grain including bran and germ as used in epi studies

WG and Coronary Disease
Intervention

- UK n=316 overweight, <1 oz WG/d
- 16 wk WHOLEheart study
  - ↑ WG consumption to 4 oz/d
- No impact on any marker of CVD
  - Is time long enough for a non-drug intervention? Is this the right population?

Brownlee et al 2009 AACC Newcastle Conference

WG and Coronary Disease

Intervention UK 48 – 96 g/d WG n= 67; wheat or rye;
8 wk GrainMark study

	0 wk WG-W	0 wk WG-R	4 wk WG-W	4 wk WG-R	8 wk WG-W	8 wk WG-R
Chol total	5.86	6.10	5.82	5.96	5.74	5.88
LDL	3.58	3.89	3.52	3.72	3.43	3.60
HDL	1.68.	1.68	1.69	1.63	1.70	1.65

Whole grain rye significantly decreases Chol and LDL

Haldar et al 2009 AACC Newcastle Conference

WG and Coronary Disease

Intervention Italy 48 – 96 g/d WG

n= 15; overweight crossover

whole wheat vs refined 3 wk

- Whole wheat compared to white
  - ⬇ Total cholesterol
  - ⬇ LDL cholesterol

Giacco et al 2009
AACC Newcastle Conference

Whole Grains and Coronary Disease – possible mechanism

- Hypercholesterolemics n=155 intervention
- 3-5 g of barley in food decrease -6 wk
- ⬇ LDL cholesterol 13-15%

Keenan et al Br J Nutr. 2007 ;97:1162-8

Whole Grains and Coronary Disease

WG and Colon Cancer - Epi

291 988 men / 197 623 women aged 50-71 y

prospective NIH-AARP Diet and Health Study

- Only grain fiber assoc with ↓ risk of colorectal cancer RR = 0.86
- Whole-grain - RR = 0.79

Schatzkin et al. Am J Clin Nutr. 2007;85:1353-60

Whole Grains and Colorectal Cancer – EPI

meta-analysis of 11 cohort studies
n= 1,719,590 ; ages 25 -76 years

Highest vs lowest WG intake

- Tumors overall RR = 0.94
- tumors – colon RR = 0.93
- tumors - rectum RR = 0.89

Haas et al Int J Food Sci Nutr. 2009 21:1-13

Whole Grains and Colon Cancer – EPI case-control

1723 newly diagnosed, histologically confirmed colon cancer cases and 3097 population controls

- 7 Canadian provinces
- No effect on colon CA
- Fruit and whole-grain products

Hu et al 2007 Eur J Cancer Prev.; 16:275-91

WG and Intestinal Cancer - Epi

293,703 men & 198,618 women
NIH--AARP Diet and Health

- Risk of small intestinal cancer
- RR = 0.79 for total dietary fiber
- RR = 0.51 for fiber from grains
- RR = 0.59 for whole grain foods

Schatzkin et al Gastroenterology. 2008; 135:1163-7

Whole Grains and Upper GI Cancer – Epi meta

6 cohort & ~40 case-control studies

- Whole grain, but not refined grain
  - ⬇ oral / pharyngeal cancer risk
- Diet ~20-25% of risk

Lucenteforte et al Oral Oncol. 2008 Nov 4. [Epub ahead of print]

Whole Grains and Breast Cancer

25,278 postmenopausal women -Danish Diet Study

- No assoc. WG intake breast cancer
  - Not affected by type
    - » tumor receptor status (estrogen or progesterone receptor)
    - » tumor histology (ductal/lobular)

Egeberg et al Int J Cancer. 2009 ;124:745-50.

WG and Cancers

- Variability in the data
- All epi data
- Data are stronger for upper GI
- Not for breast

Whole Grains and the Link to Chronic Disease

- Observational vs interventions
  - Strength/ Weakness of each
  - What is the value of both kinds of data?
  - Are RCT the gold standard?
  - Do we weight this type of evidence too heavily?
- Should clinical trials be done on healthy people?

Why Data Seem to Confute

- Who are the subjects?
  - Different subjects - varying alleles
- What is fed and what is the control?
  - Mix of Grains – varying effects of barley vs oats vs rye etc

Why Data Seem to Confute

- Different Whole Grains have
  - Varying nutrients and fiber types
  - modes of preparation and processing
  - varying toxicants

Definition of a Whole Grain Food in Epi Studies

Foods classed WG - if at least 25% WG or bran by weight.

- <51% as health claim requires
- Arbitrary cut off point
- Included pure bran & germ and all barley, bulgur, and cous cous

de Munter et al PLoS Med. 2007 ;4(8):e261

Why Data Seem to Confute

- What is the control?
  - Do you compare WG to same diets with refined products?
  - Do you simply say “pick more WG products” as part of regular diet?
    - Eg Emulates dietary guidance

Why Data Seem to Confute

- Do changes in a marker for disease change disease risk?
- Length
  - How do 3-16 weeks for an intervention compare with regular eating patterns?

Despite confusion, the following conclusion from C&E Spring Meeting 2009 Whole Grain Global Summit

Conclusions from WG Summit

There is sufficient evidence showing that higher whole grain diets compared to refined grains diets are beneficial for several health outcomes. High bran/fibre are not equal to whole grain diets but also have beneficial relationship with health.

C&E Spring Meeting 2009—Whole Grain Global Summit

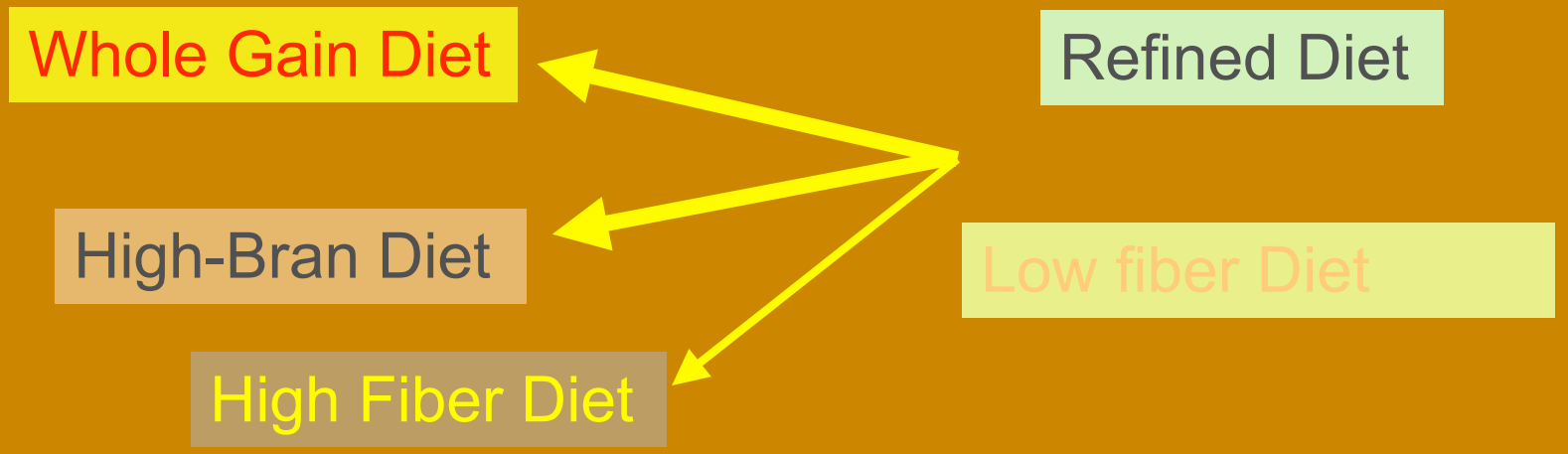
Conclusions from WG Summit

- Not all whole grains (or fibres) have equal effects on health or equal levels of evidence.

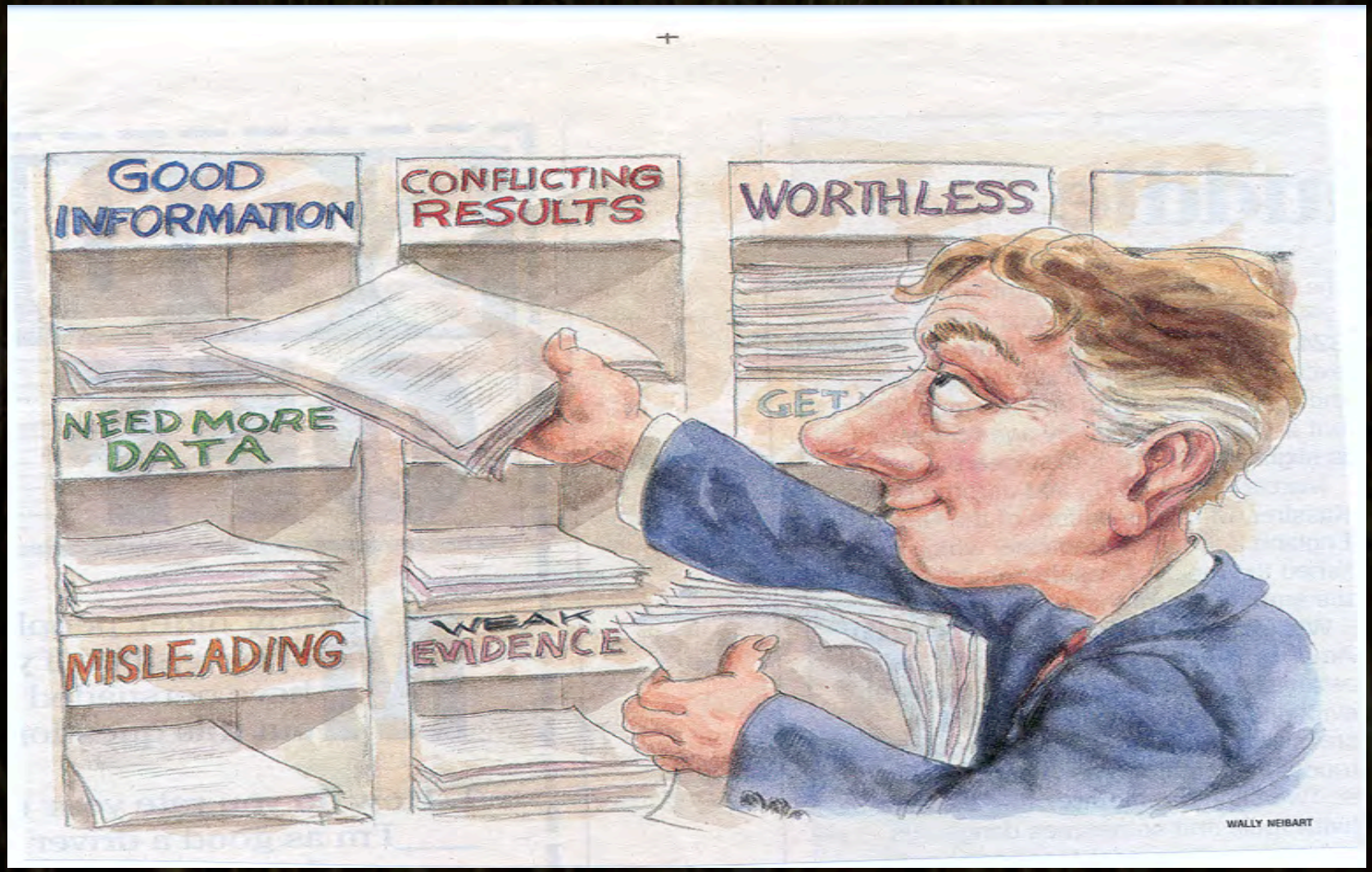
C&E Spring Meeting 2009—Whole Grain Global Summit

Conclusions:

- Public Health: replace at least part of the refined foods in the diet with whole grain choices including high-bran and high-fibre alternatives.



C&E Spring Meeting 2009—Whole Grain Global Summit


GOOD INFORMATION
CONFLICTING RESULTS
WORTHLESS
NEED MORE DATA
MISLEADING
WEAK EVIDENCE
WALLY NEIBART

Do Whole Grains Improve Our Health?

- Whole grains in epidemiological studies are associated with reduced risk of hypertension, CVD, diabetes, weight gain and certain types of cancer.
- Whole grains are a healthy choice.

Whole Grains Still Are - Not on Menu


HEALTHY LIVING, HEALTHY EATING
IT CHANGED MY LOOKS - IT CHANGED MY LIFE!
It's full of fiber