

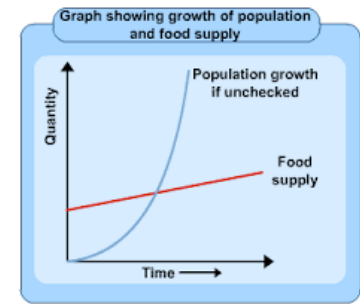
What If the World Went Gluten Free and Grain Free: The Role of Grains in the Diet and Feeding the World

CIMMYT 50

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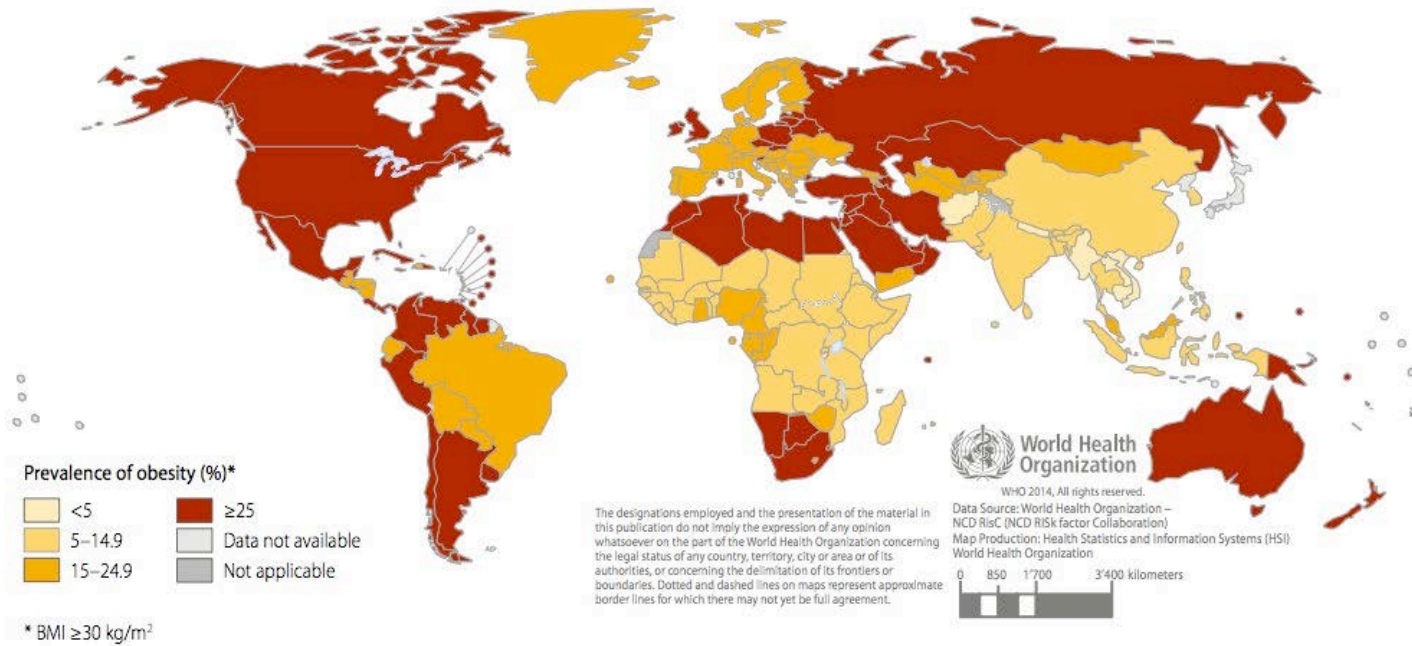


What this talk will cover



- Today's environment – obesity, type 2 diabetes
- What is being said about celiac, gluten-free and grain-free (Paleo)? The gluten free trend.
 - What is the truth behind it?
- What are the nutritional ramifications of whole and refined grains and gluten free and grain free?
- What are the sustainability ramifications of gluten free and grain free as the world looks to feed itself by 2050?

Fig. 7.2 Age-standardized prevalence of obesity in women aged 18 years and over (BMI ≥ 30 kg/m²), 2014



FEAR THAT CARBOHYDRATES AND GRAINS CAUSING OBESITY AND CHRONIC DISEASE

White Flour is a
poison that is
addictive making us
fat and causing
diabetes.

Grains
developed by
Borlaug are
slowly killing
you.

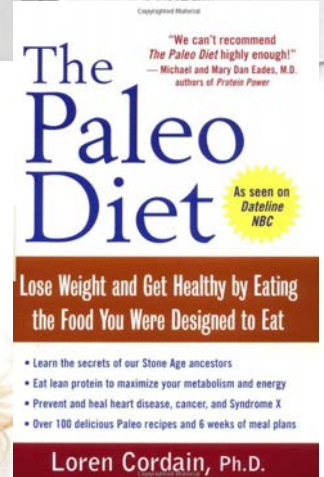
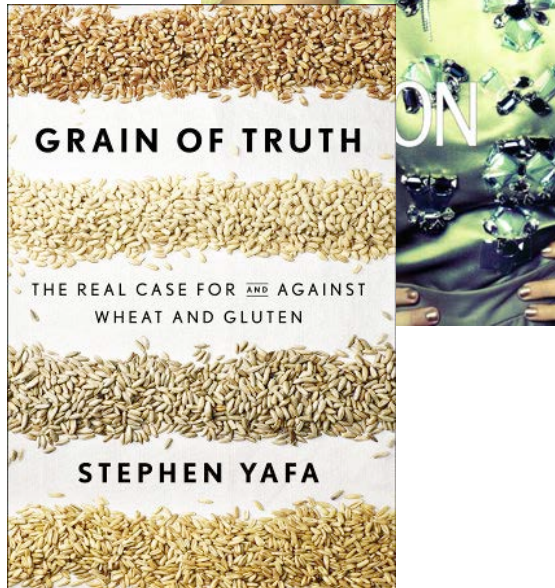
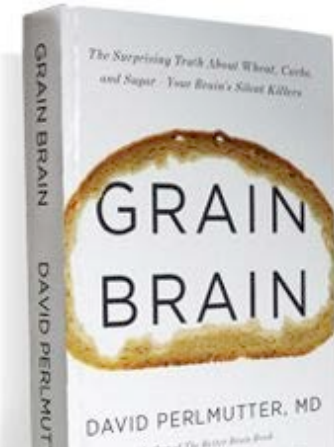
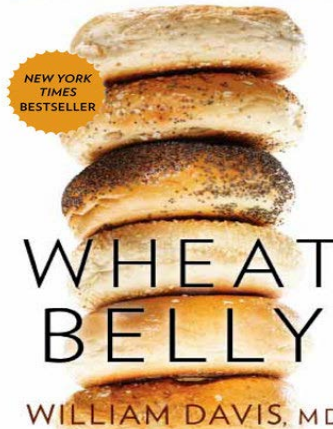
We did
not evolve
to eat
wheat.



Paleo, Gluten Free and Grain Free



LOSE THE WHEAT, LOSE THE WEIGHT,
AND FIND YOUR PATH BACK TO HEALTH



... mega-sellers like Grain Brain and Wheat Belly suggest that wheat may be the new asbestos



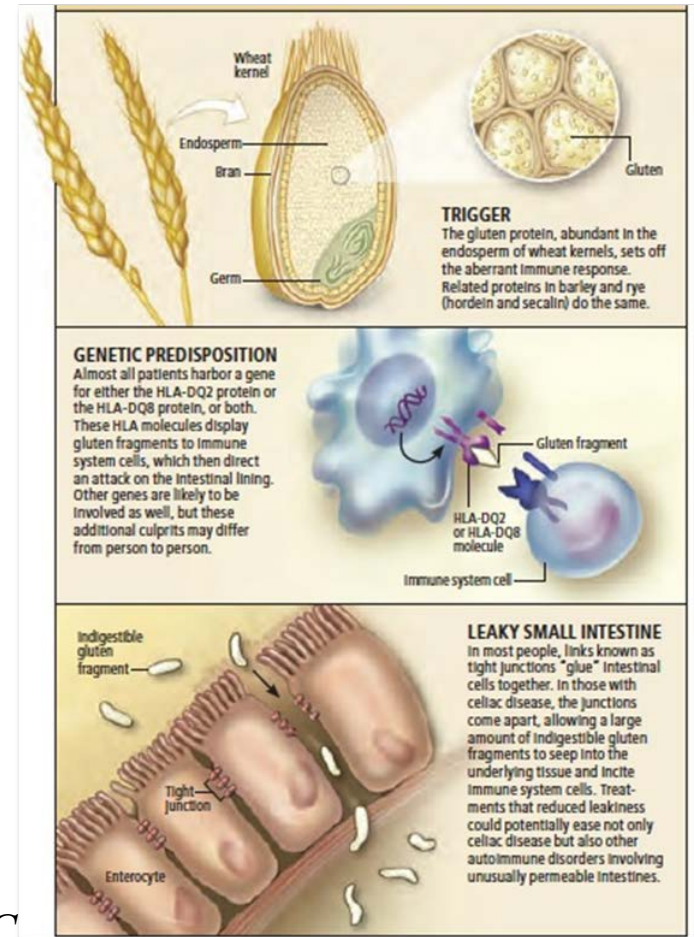
Celiac Disease Trifecta Factors

Factors that must be present

1. Gluten in the diet
2. Carry the gene- Human leukocyte antigen HLA-DQ2 or DQ8 plus others
3. Intestinal permeability
 - Emerging factor may be due to poor diets, bacterial overgrowth

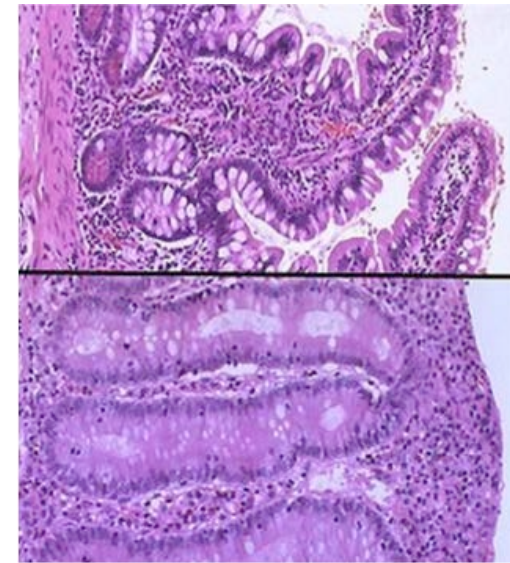
→ Inflammation

Fasano, A. (2009, August). Celiac Disease Insights: Clues to Solving Autoimmunity. Scientific American.



How Common is Celiac Disease?

- North American 1 / 133 < 1%
- Global impact - varies by race and ethnicity
- Runs in families - 1/22 to 1/39
- In people with related gut symptoms: 1 in 56
 - Common GI symptoms include diarrhea, constipation, bloating, malabsorption
- All autoimmune disease is increasing. Why?



EAT



AVOID



**CLAIM: HUMANS DID NOT
EVOLVE TO EAT GRAINS;
PALEO DIETS ARE BETTER**



**The
Paleo
Diet**

Loaf, Weigh In, and Get Healthy
By Taking the Foods
That Were Designed to Eat

Loren Cordain, Ph.D.

Claim: Humans Did Not Evolve to Eat Grains

- Humans -eating grains >100,000 yrs
- **Dental record evidence**
 - Teeth show we were/ are omnivores.
 - Cooked grain DNA was found in **dental calculus** of Paleolithic humans
- **Cave and cooking evidence***
 - Grains (sorghum, wild maize, others) found in caves
 - Grain DNA on stone tools and cooking pots
→ indicate processing and cooking of grains

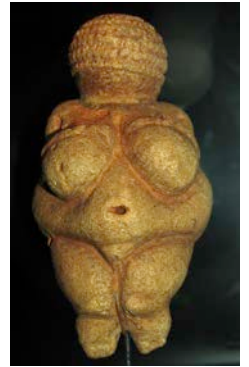


*Caves in Iraq and the Low Countries; the Americas

Henry, A. et al. *Ethology & Sociobiology* 15: 219–35; Unger, P. The known, the unknown and the unknowable DOI:10.1016/0162-3095(94)90015-9.

Grains and CHOS and Evolution

- With the advent of Agriculture
- Humans **evolved** to have **6 copies of amylase**
 - other primates - 2 copies
- Amylase & cooking
 - Enabled ready supply of glucose to the brain
 - the brain's preference for fuel
- Cooked CHO staples / food may have enabled evolution
- Teleological argument - If wheat wasn't eaten, why would it be domesticated?



Haslam & Rigby. A long look at obesity. Lancet.2010;376:85–86

<http://news.sciencemag.org/evolution/2012/10/raw-food-not-enough-feed-big-brains>

[news.nationalgeographic.com/.../121026-human-cooking-e...- A surge in human brain size about 1.8 million years ago is linked to the innovation of cooking](http://news.nationalgeographic.com/.../121026-human-cooking-e...)



**CLAIM: GRAINS/ GLUTEN-
CONTAINING CARBOHYDRATE
STAPLES ARE BAD FOR THE
HUMAN DIET**



Recommendations for Carbohydrates (CHO) and CHO Staples

- Dietary recommendations - most countries /health promotion orgs
- Food guidelines recommend grains as a food group
- **CHO/ grain staples - Base of pyramid/ diet**
- **45-65% of E (up to 75%of E)**
 - Australia / New Zealand Dietary Guidelines
 - European Food Safety Authority
 - UK Scientific advisory Committee on Nutrition
 - US Dietary Guidelines / US Institute of Medicine
 - Singapore Health Promotion Board
 - Indian Health
 - Health promotion bodies such as heart, cancer and diabetes associations
- World Health Organization/ Food & Agriculture Organization (WHO/FAO)
- *“the macronutrient that humans need in the largest quantity.”*



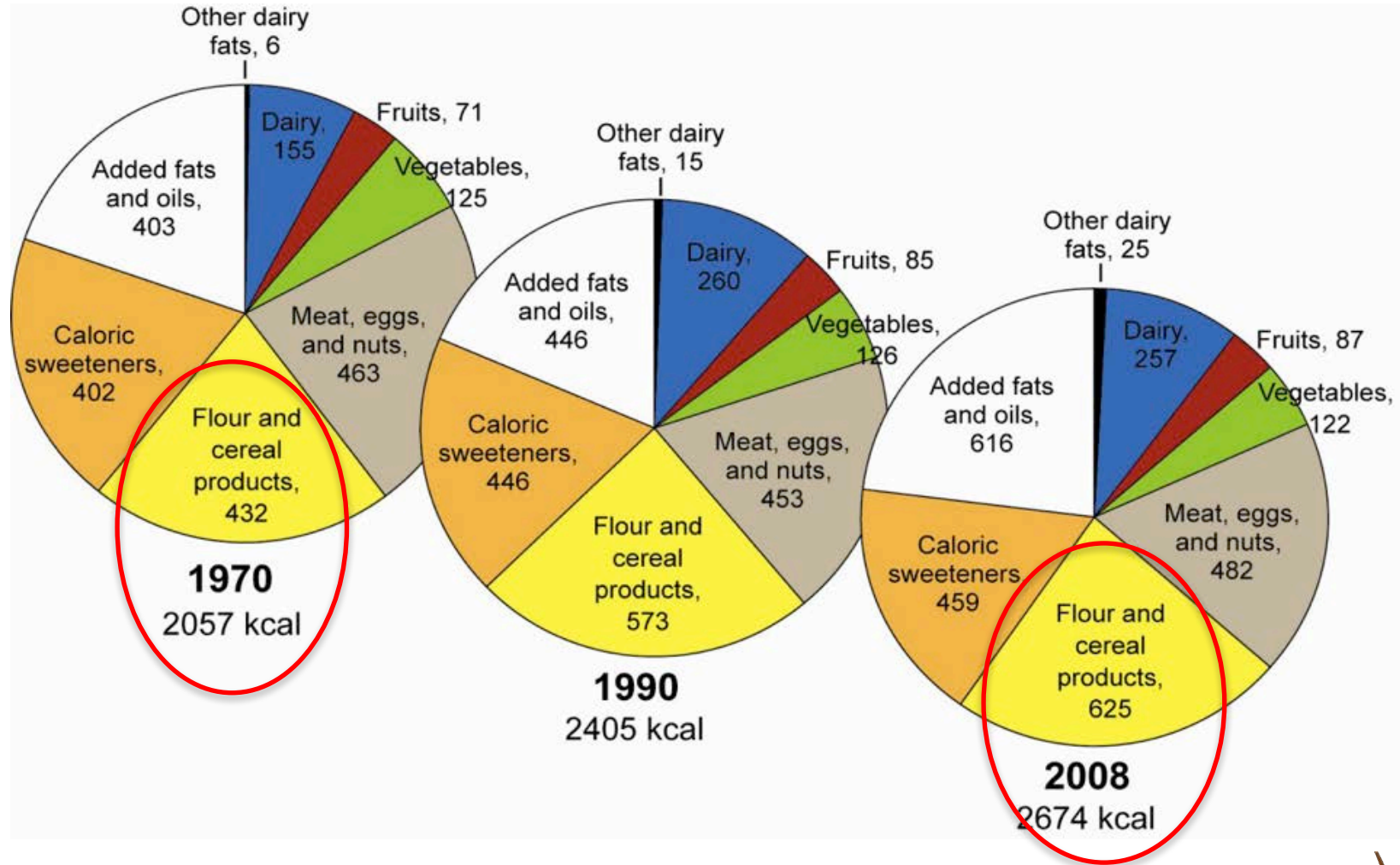
Montagnese C et al Nutrition. 2015 ;31:908-915; Radhika G, et al Public Health Nutr. 2011 ;14:59

<http://www.hpb.gov.sg/HOPPortal/health-article/2638>

Dietary Guidance - Some Examples



Too Many Calories = Excess Weight



~ 600 Kcal more overall, ~200 calories more each from fat and CHO; 50 cal more from sweeteners

Grain Intake Is Flat or Decreasing as Obesity Climbs

Past and projected future overweight rates in selected OECD countries

Figure 1
The share of dietary energy derived from cereals

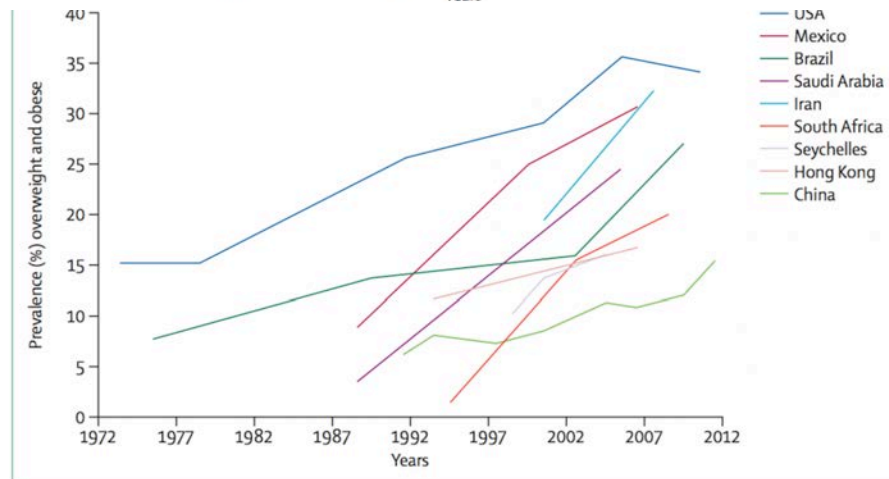
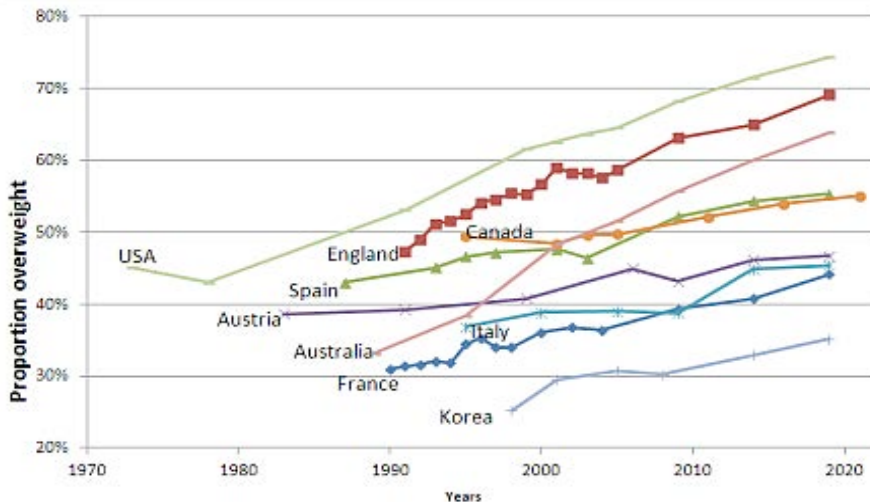
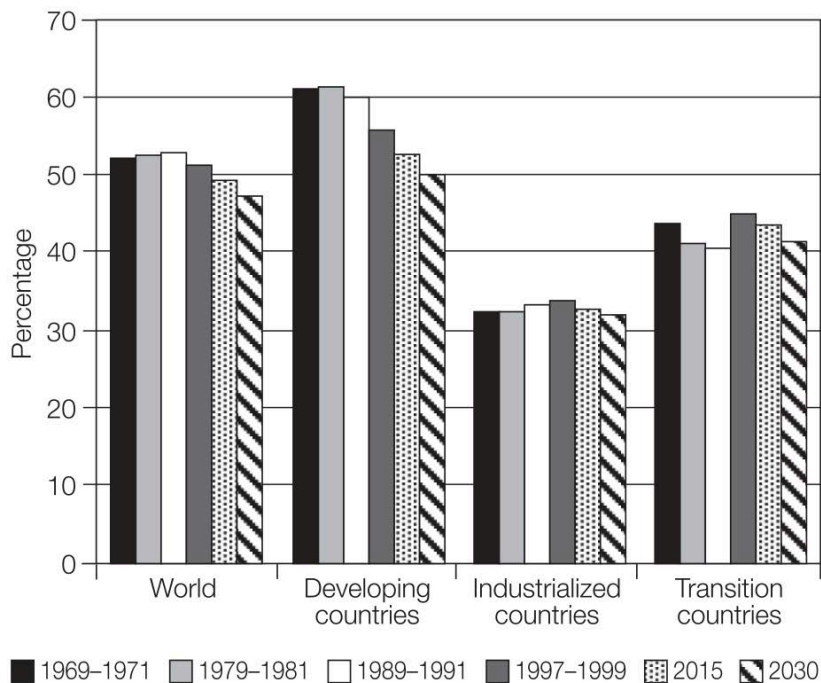


Figure 1: Prevalence trends for child overweight and obesity in the USA and eight low-income and middle-income countries

Source: World Obesity Federation, collated from published sources. Further details in appendix. Measurements of body-mass index are based on professionally measured heights and weights.

<http://www.fao.org/docrep/005/ac911e/ac911e05.htm>



Whole Grain – Rich in Nutrients

14% Bran

“Outer shell” protects seed

- Fiber
- B Vitamins
- Trace Minerals

2-3% Germ

Nourishment for the seed

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

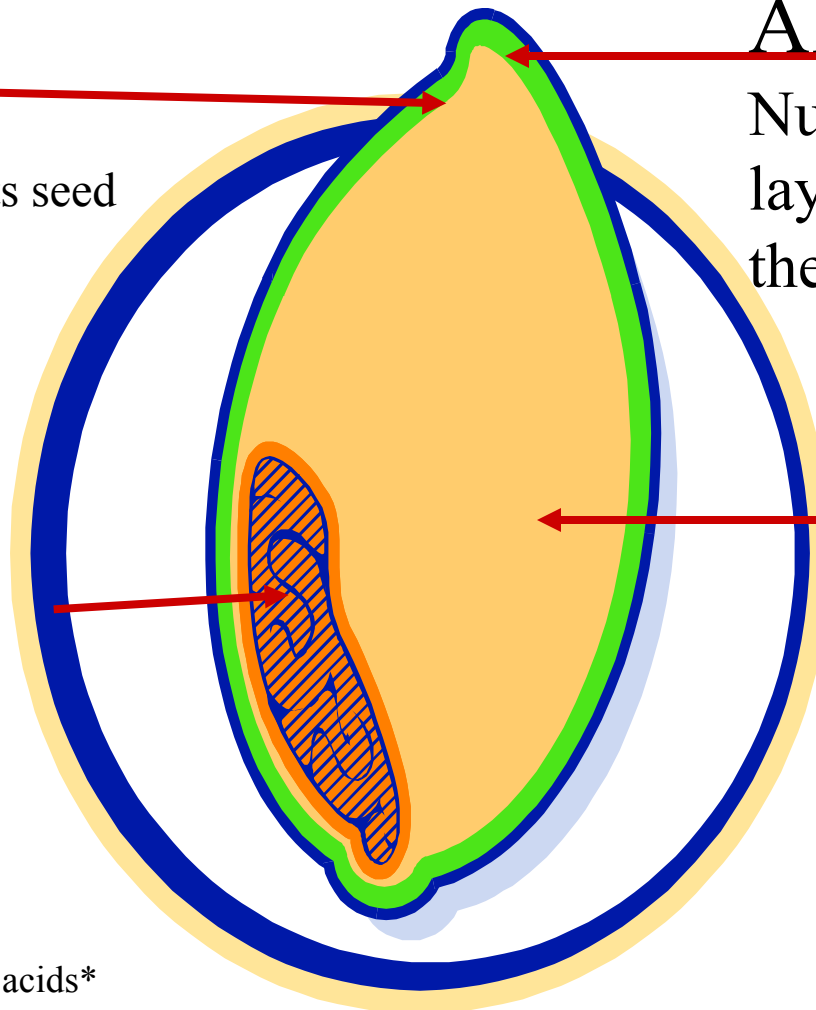
Aleurone

Nutrient –rich layer under the bran

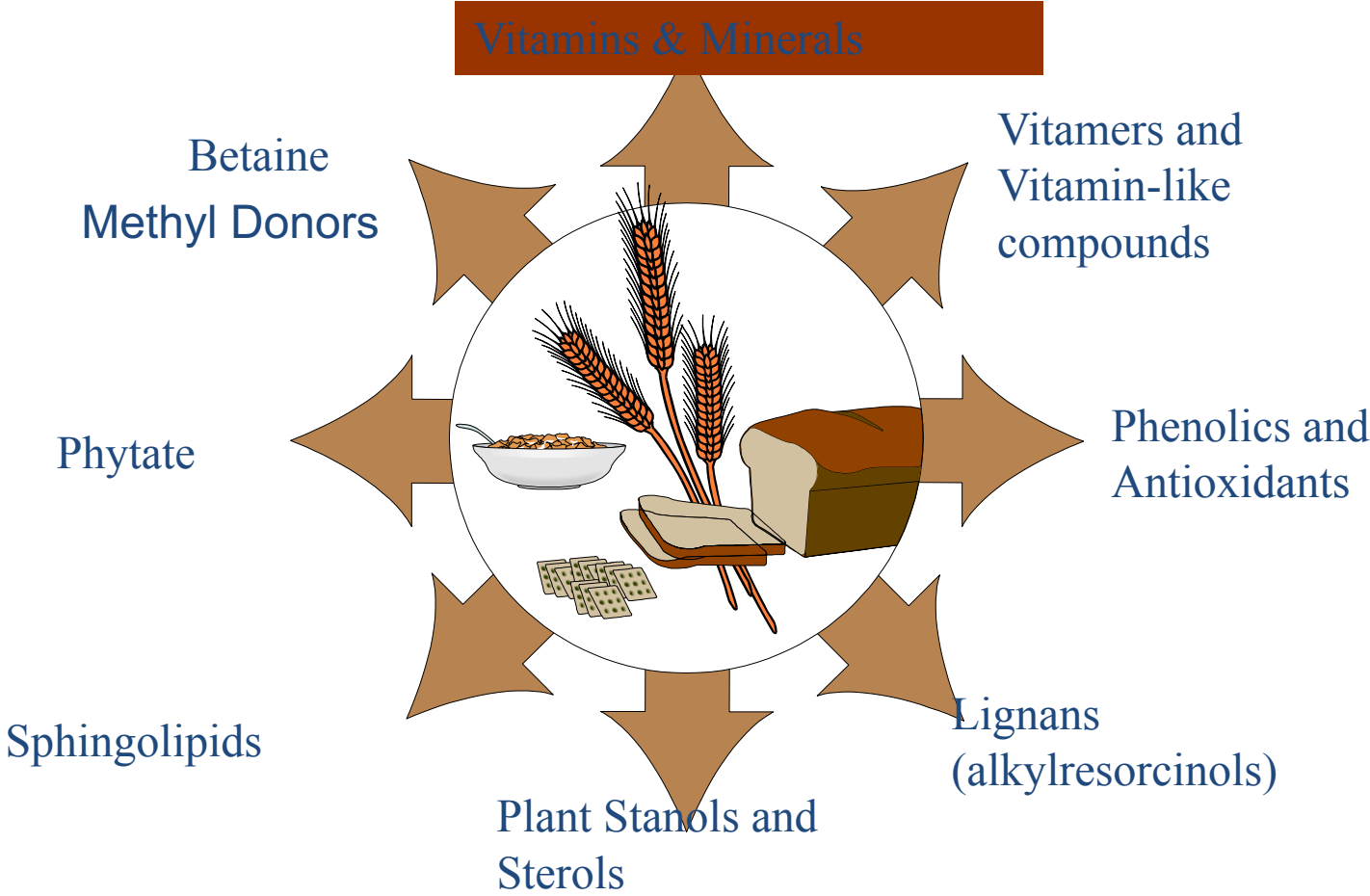
83% Endosperm

Provides energy

- Carbohydrate
- Protein
- Some B Vitamins



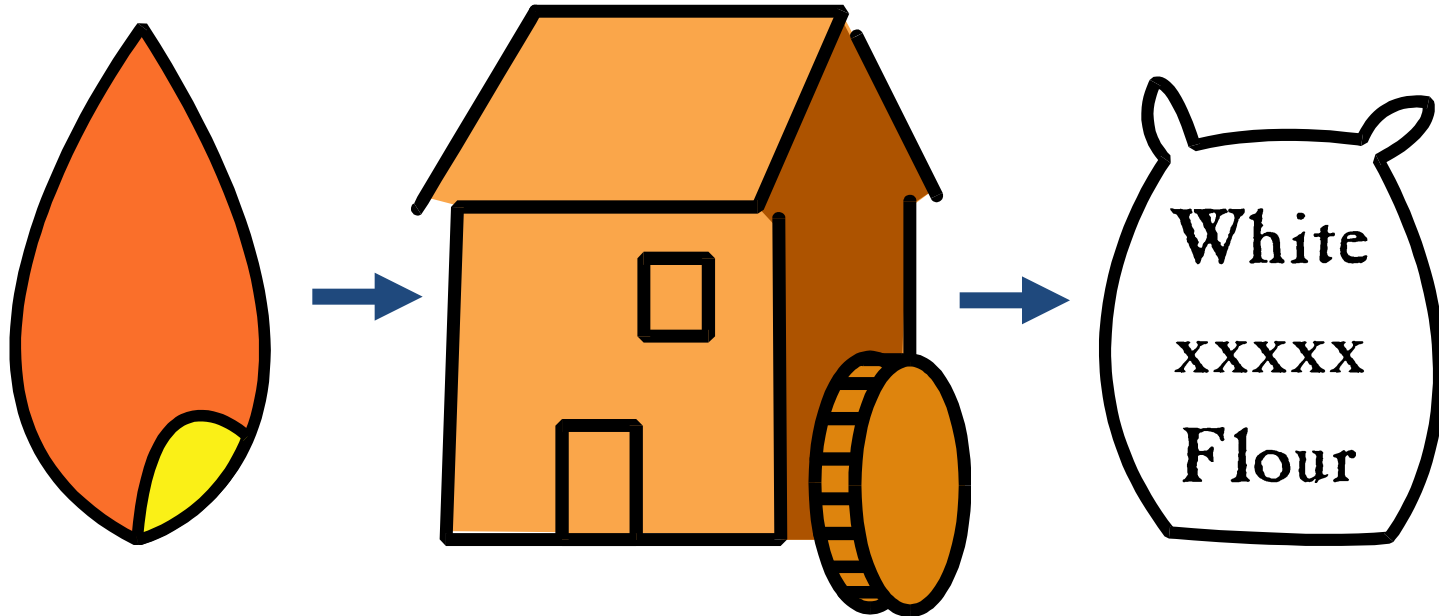
Whole Grain Nutrients and Phytochemicals



Slide adapted with permission from Gene Miller, GMI



Whole Grain vs Refined Grain



Whole Grain
100% of
Phytonutrients

Mill

Refined Grain
15-35% of
Phytonutrients

Loses Most of the Fiber

REFINING REMOVES ABOUT 75% OF PHYTONUTRIENTS

Whole vs. Refined

What's lost when whole grains are refined? This graph shows how much of 15 nutrients in whole wheat flour is left after it's milled into enriched white flour.



* = This nutrient has been added to enriched white flour.

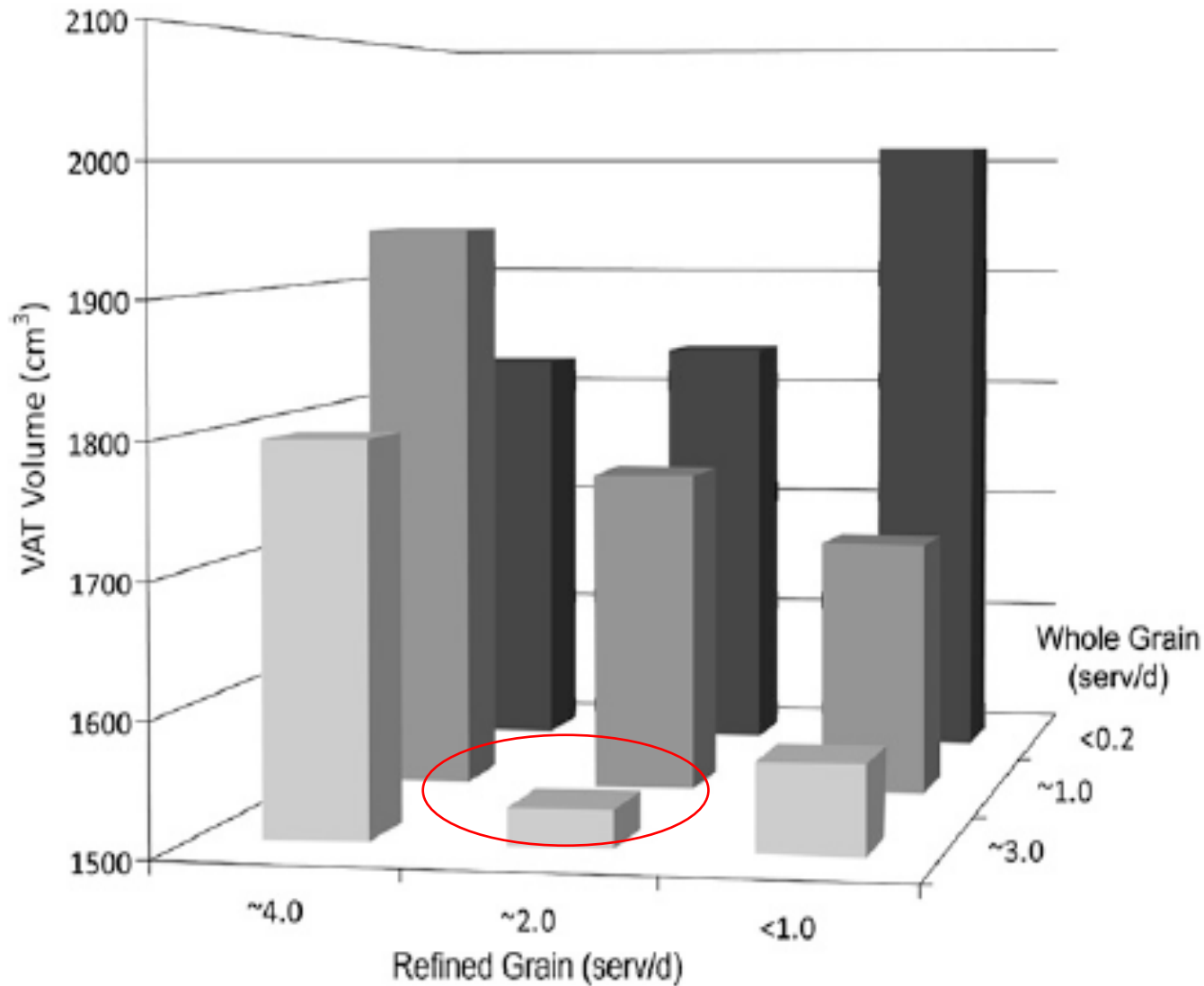
Source: USDA Nutrient Database for Standard Reference, Release 11 (www.nal.usda.gov/fnic/foodcomp).

■ = Enriched white flour.



Mix of Whole and Refined Grains

Lowest Visceral Abdominal Fat



Whole Grain Intake Lowers Relative Risk (RR)

90 g/day increase in whole grain intake (3 servings)

2 sl. bread, 1 bowl of cereal or 1/5 sv. pita bread made from whole grains)

Very similar Relative Risks (RR) for both incidence and mortality

0.49 Diabetes

0.81 Coronary heart disease

0.78 Cardiovascular disease

0.88 Stroke

0.85 Total cancers

0.83 Death from all causes

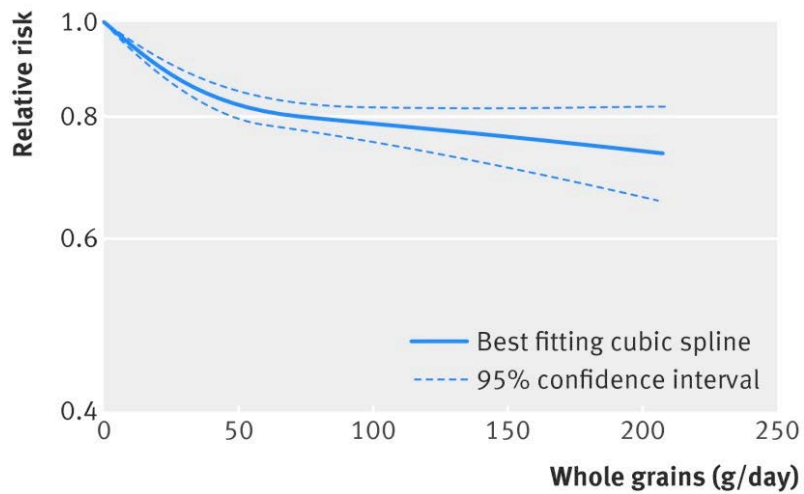
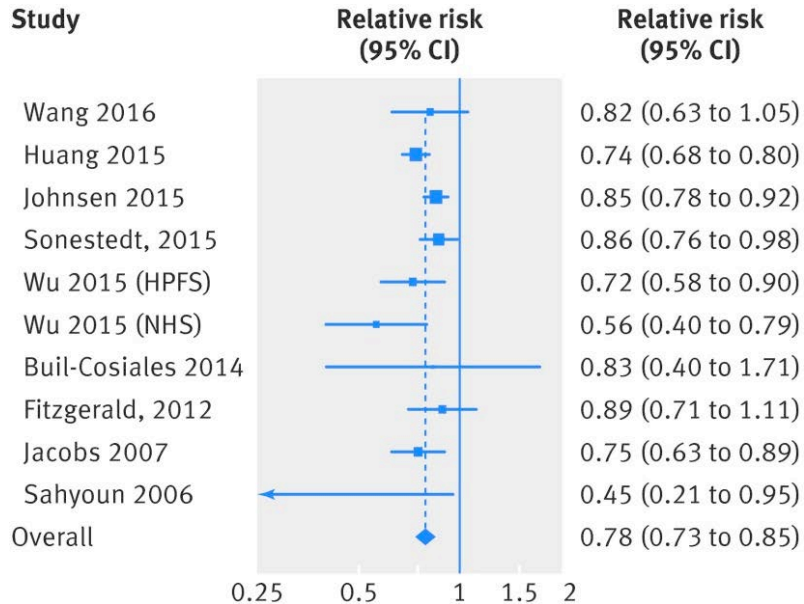
Meta-analysis of 45 prospective cohorts (64 publications)

Aune D, et al BMJ. 2016 Jun 14;353:i2716



Whole Grains / Coronary Disease

Ave 22% Decreased Risk



Meta-analysis of 45 prospective cohorts (64 publications)

Aune D, et al BMJ. 2016 Jun 14;353:i2716;
Tang G et al Am J Cardiol. 2015;115:625-9.

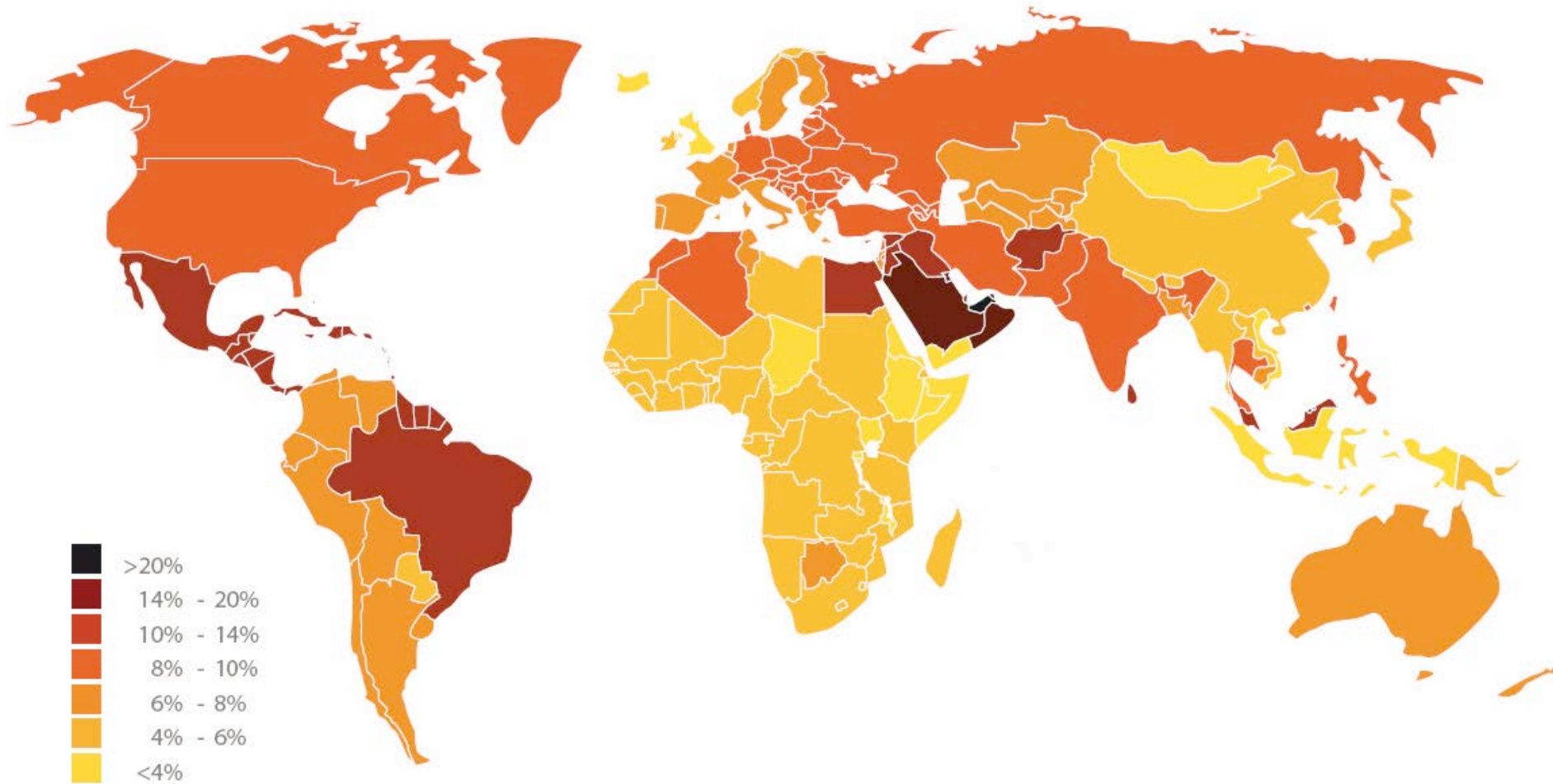


prediabetes
High cholesterol
Physical inactivity
Anemia
metabolic syndrome Unhealthy diet
Sleep apnea
Too much alcohol Family history high triglycerides
High blood pressure Birth control
Stress preeclampsia Overweight obesity
depression Smoking Diabetes

CARBOHYDRATES, GRAINS AND WHOLE GRAINS DIABETES



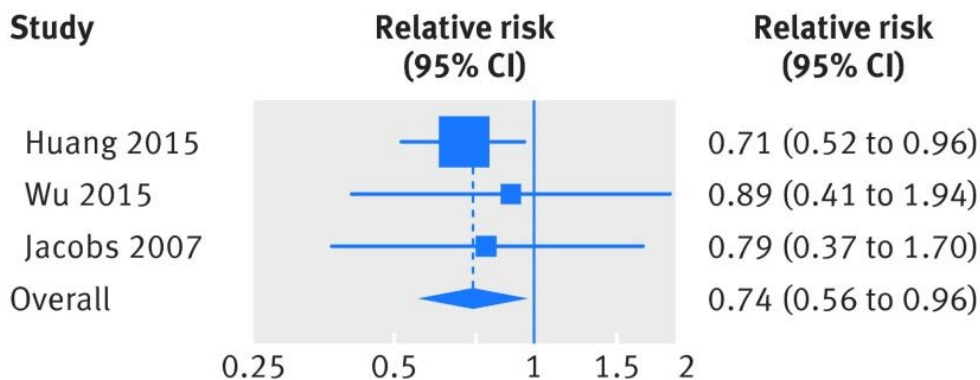
Prevalence estimates of diabetes, 2025



SOURCE: DIABETES ATLAS THIRD EDITION, © INTERNATIONAL DIABETES FEDERATION, 2006

Whole Grain Intake & Type 2 Diabetes Risk

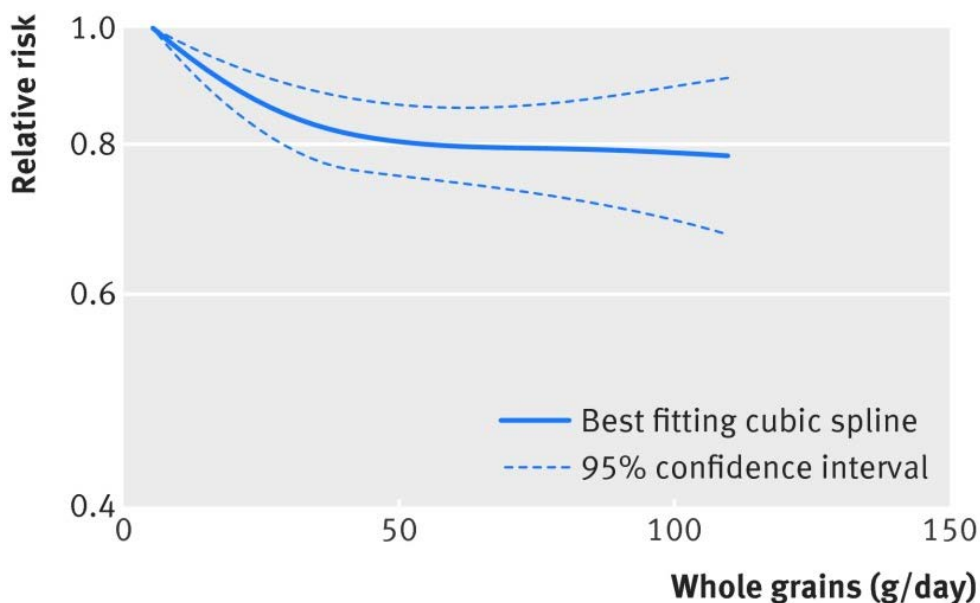
~ 25% Lower risk



Recommended Foods for Diabetics

Healthy Carbohydrates:

- ✓ Fruits
- ✓ Vegetables
- ✓ Whole grains
- ✓ Legumes (beans, peas, lentils)
- ✓ Low-fat dairy products



Meta-analysis of 45 prospective cohorts
(64 publications)

Aune D, et al BMJ. 2016 Jun 14;353:i2716



Carbohydrate Intake & Type 2 Diabetes Risk

Nurses Health Study N > 70,000

RR Type 2 diabetes (T2D)

CHO RR = 0.98 ns

Starch RR = 1.23**

Total fiber RR = 0.80**

Cereal fiber RR = 0.71**

Fruit fiber RR = 0.79**

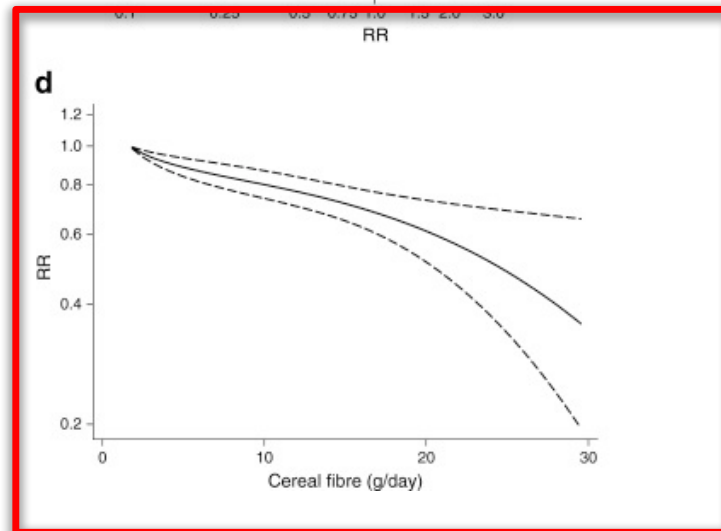
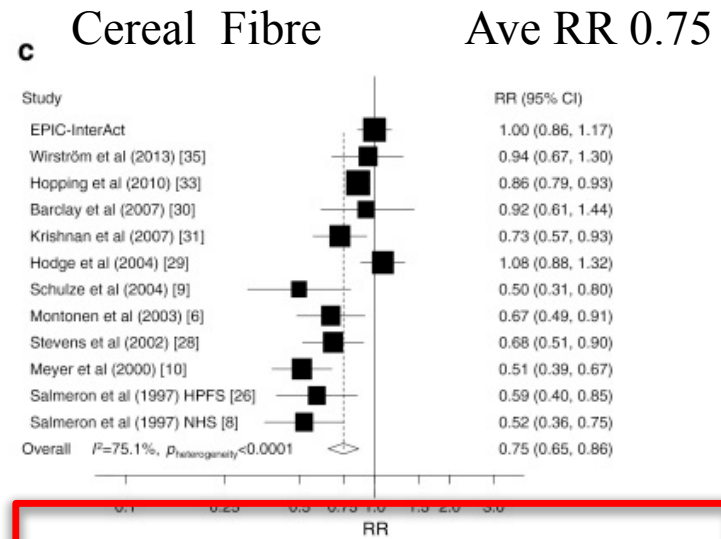
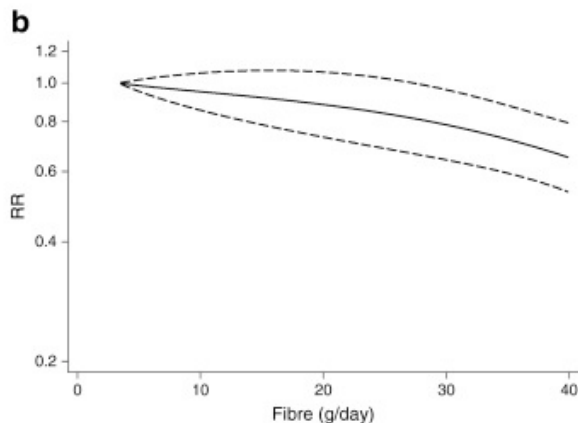
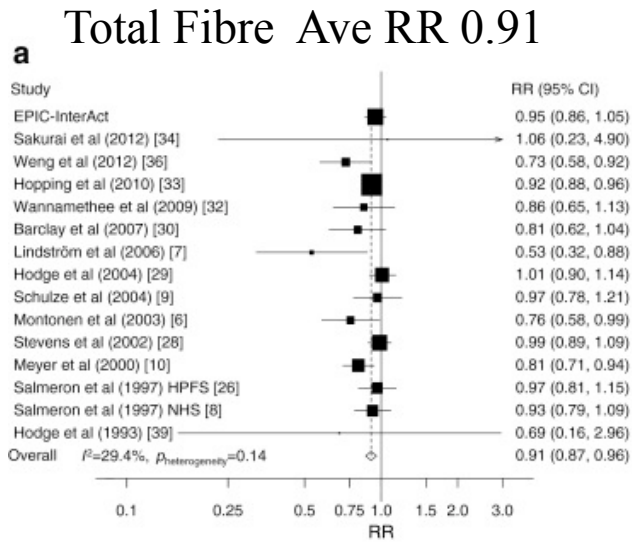
CHO:cereal fiber RR = 1.28**



Diets with high starch, low fiber, and a high starch-to-cereal fiber ratio were associated with a higher risk of T2D.

➔ need to increase fiber and whole grain

Total Fibre (a,b) and Cereal Fibre (c,d) Intake and Type 2 Diabetes Relative Risk



Claim: All Fibers from All Sources Have the Same Impact So Grains Aren't Necessary

Fibers & Small Intestinal Cancer

RR

Total Dietary Fiber	0.79	ns
Cereal Fiber	0.51	P < 0.01
Whole Grain foods	0.59	P < 0.06



"FRANKLY, DEAR, I THINK YOU'VE BEEN ON THIS PALEO DIET MUCH TOO LONG!"

U.S.NIH AARP N= 560,000 older adults

Schatzkin et al Gastroenterology 2009 135:1163-7

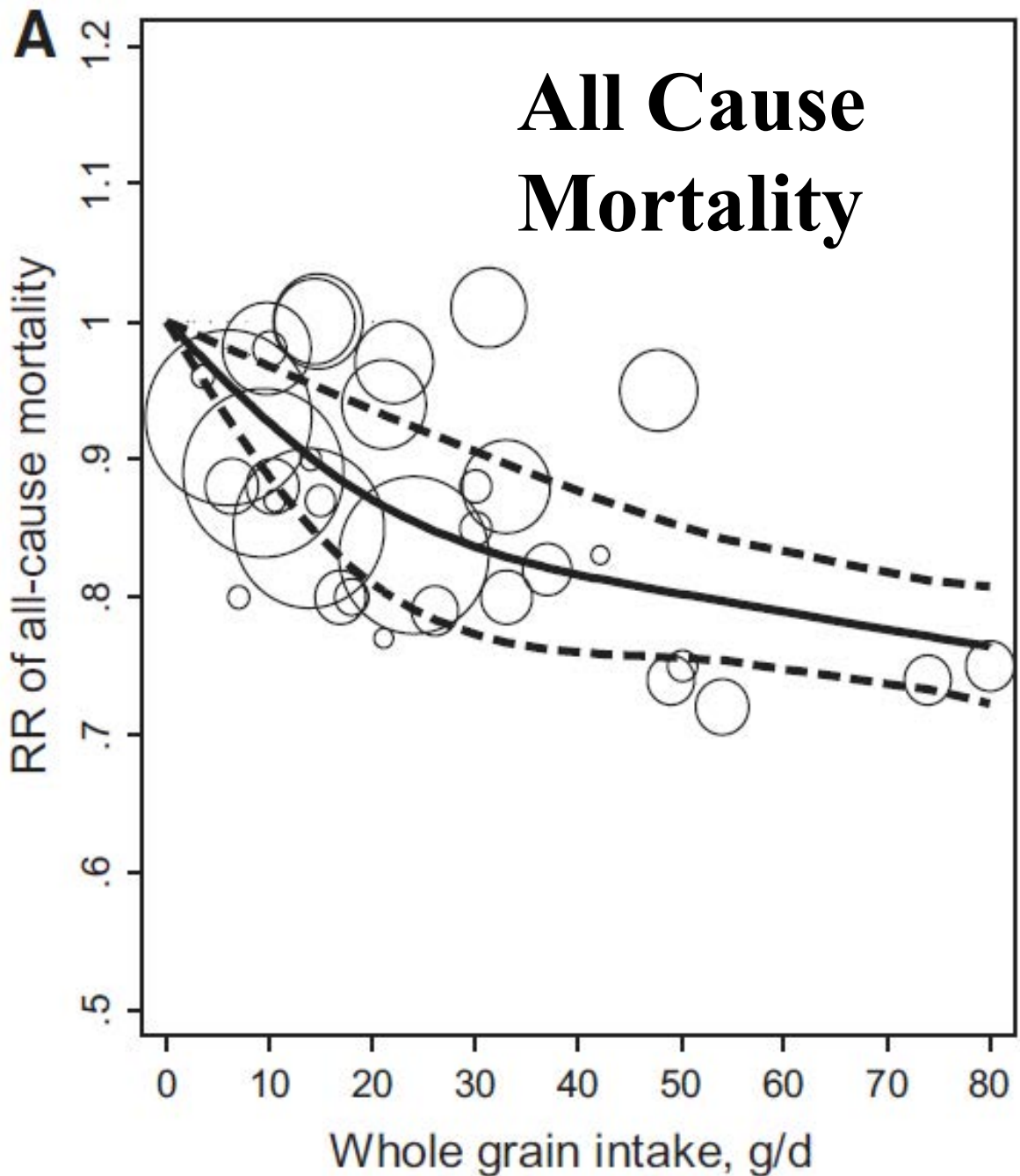


Claim :All Fibers Are the Same

Fiber and Laxation

<u>FIBER</u>	<u>LAXATION</u> per g fiber fed
Wheat bran	5.4
Psyllium	4.0
Oats	3.4
Corn	3.3
Legumes	2.2
Pectin	1.2
RS2 resistant starch	1.1
Inulin	1.0





Whole Grain Intake and All-Cause Mortality

Zong et al, *Circulation*
2016;133:2370-2380



NOT Getting the Recommended 3 Servings of Whole Grains Each Day!

Not Enough Cereal and Total Fiber

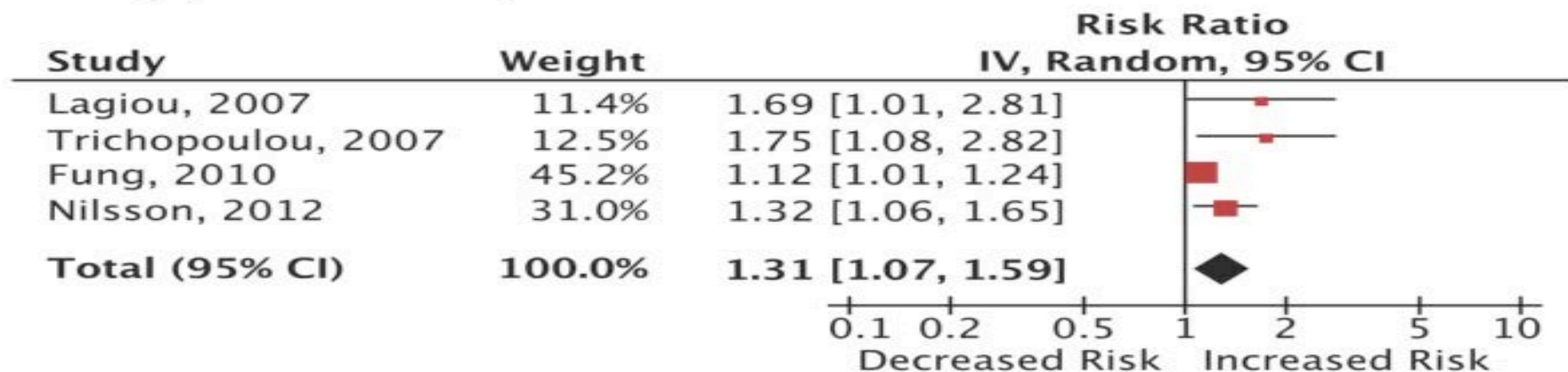


Not Getting Enough
Whole Grain

**Getting the
Recommended
3 Servings of
Whole Grain/Day**

Low-carb diets and all-cause mortality

(A) Low-carbohydrate score



Heterogeneity: $\text{Tau}^2 = 0.02$; $\text{Chi}^2 = 6.44$, $\text{df} = 3$ ($P = 0.09$); $I^2 = 53\%$
Test for overall effect: $Z = 2.68$ ($P = 0.007$)

Meta-analysis - 17 studies $n = 272,216$

- High low-carb score associated with increase in all-cause mortality $\text{RR} = 1.31$

Noto H et al PLoS One. 2013;8(1):e55030.

Cost and Quality of Grain/ Gluten Free/ Diets

- **Gluten – free/ Grain -free diets – Cost 2x more \$\$**
 - May be less nutritious and may not be fortified

[Martin J](#), [Geisel T](#), [Maresch C](#), [Krieger K](#), [Stein J](#).
[Digestion](#). 2013;87(4):240-6. doi: 10.1159/000348850. Epub 2013 Jun 6.

Inadequate nutrient intake in patients with celiac disease: results from a German dietary survey.

- **Inadequate B vitamins, Ca⁺⁺ and cereal / legume fiber**
- **Environmentally expensive**

Metzgar M et al. Nutr Res. 2011;31:444-51.



Feeding the 8 Billion in 2030

Grains 73% -harvested acres

– >50% world's calories

By 2050 Need ↑>>40%

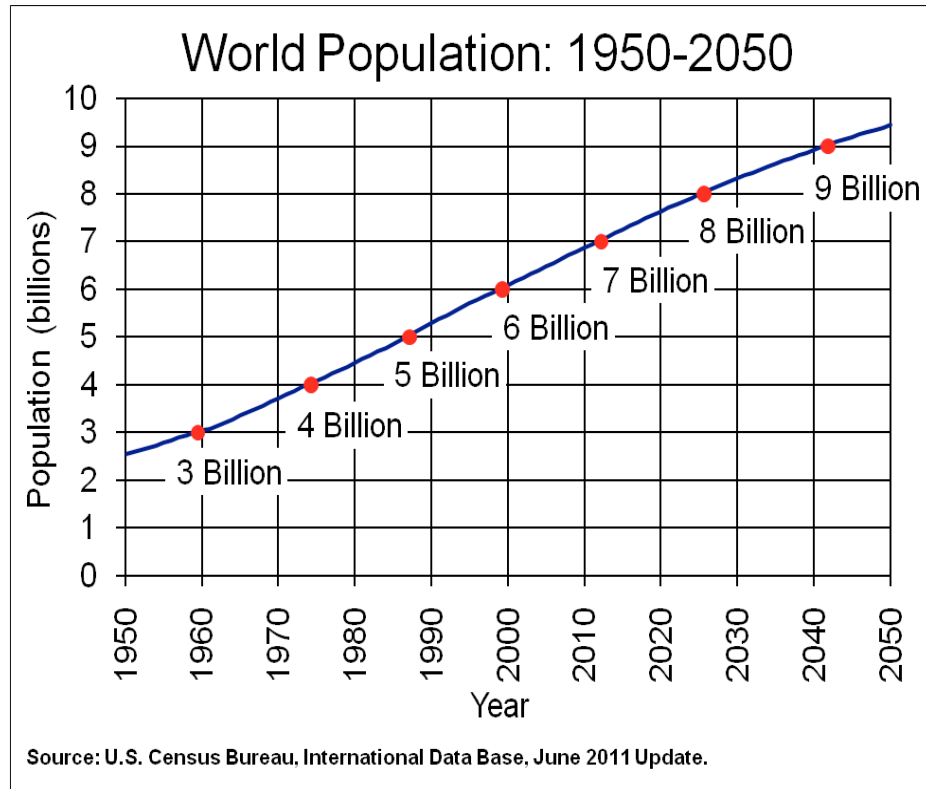
esp if ↑meat-rich diet

- intensive production ↑80%

– ↑20% - arable land (forests, parks???)

– *"Sustainable intensification without further degradation of natural resources and environment still remains a challenge..."*

FAO 2000 report *Agriculture: Towards 2015/2030*.



Krishna&Chandrasekaran. Cereal Products in Valorization of Food Processing By-Products. Ed M. Chandrasekaran. 2013, p.304.

[FAO, 2000. Agriculture: Towards 2015/2030.](#)



Contribution of Grains to Feeding the World

- Maize, Wheat, Rice
 - $\frac{2}{3}$ calories for the world
- Maize, Wheat, Rice, Barley
 - $\frac{3}{4}$ calories for the world
- Wheat, maize, rice, barley, sorghum, oats, rye, millet – $\frac{1}{2}$ the world's protein
- 50,000 edible plants, but 15 crop plants
 - -90% world's calories



<http://www.fao.org/docrep/u8480e/u8480e07.htm>

Conte, R. Hunger Math: World Hunger by the numbers.

Nutritional Contribution of Various Plants

Traditional Grains

- >1000 kcal/m²
- >400 kg protein/ ha

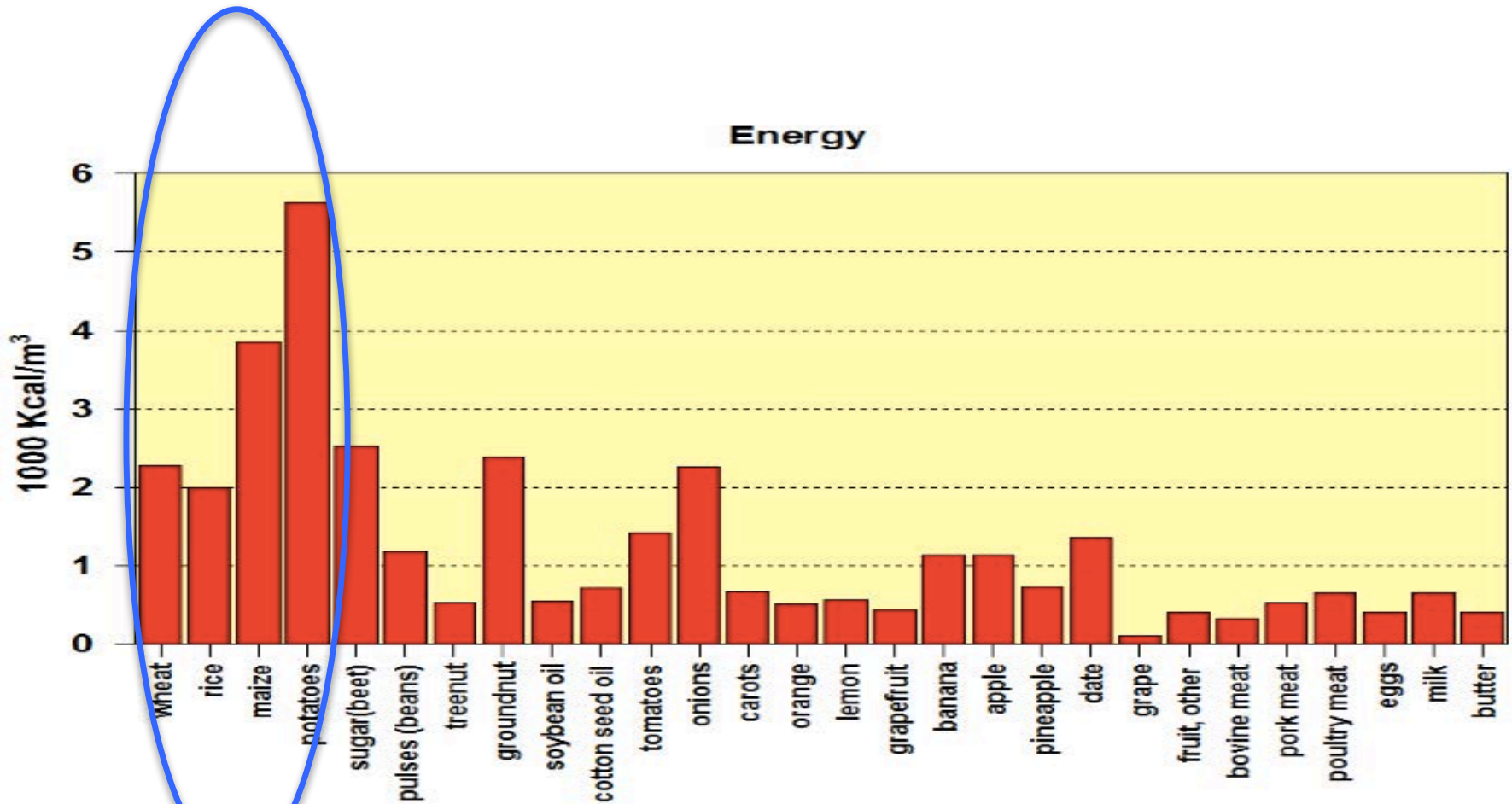
Hunger Math: World Hunger by the Numbers. Conte, R. 2013

Cereal/Pseudocereal	Calories/ m ³	Protein (kg/ha)
Maize (corn)	1,847	415
Oats	1,508	384
Rice (paddy)	1,482	307
Triticale	1,256	470
Amaranth	1,133	418
Wheat	1,083	423
Rye	914	271
Teff	605	226
Sorghum	529	165
Millet	345	105
Quinoa	275	109

Non-grain		
Soybean	1,029	870
Lentils	322	244
Green Beans	229	127

Go with the grain.

Calories /Unit Area by Crop

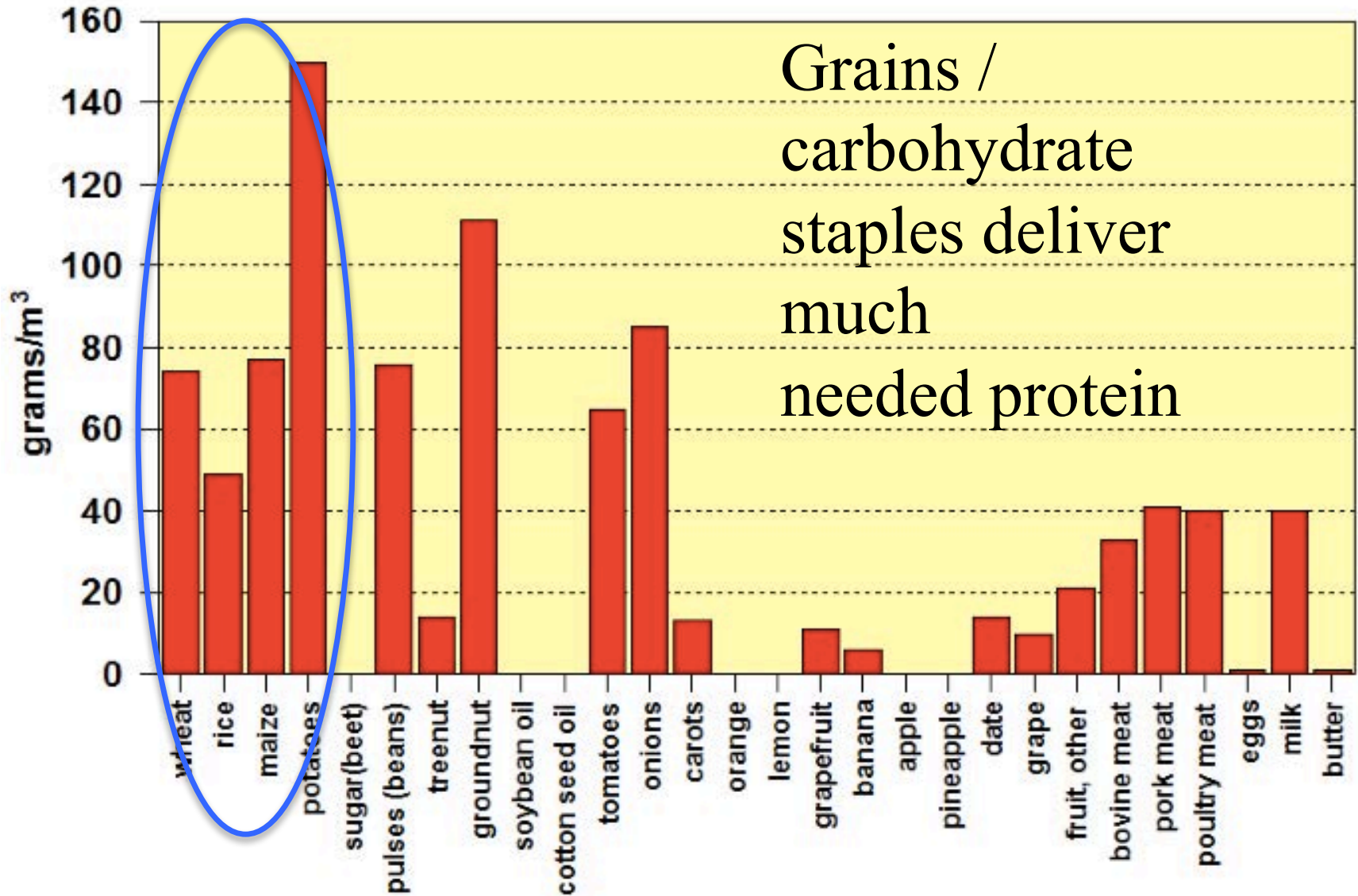


W. W. Wallender, UC Davis With permission

Grains / carbohydrate staples deliver much calories



Protein (g) /m³ by Crop

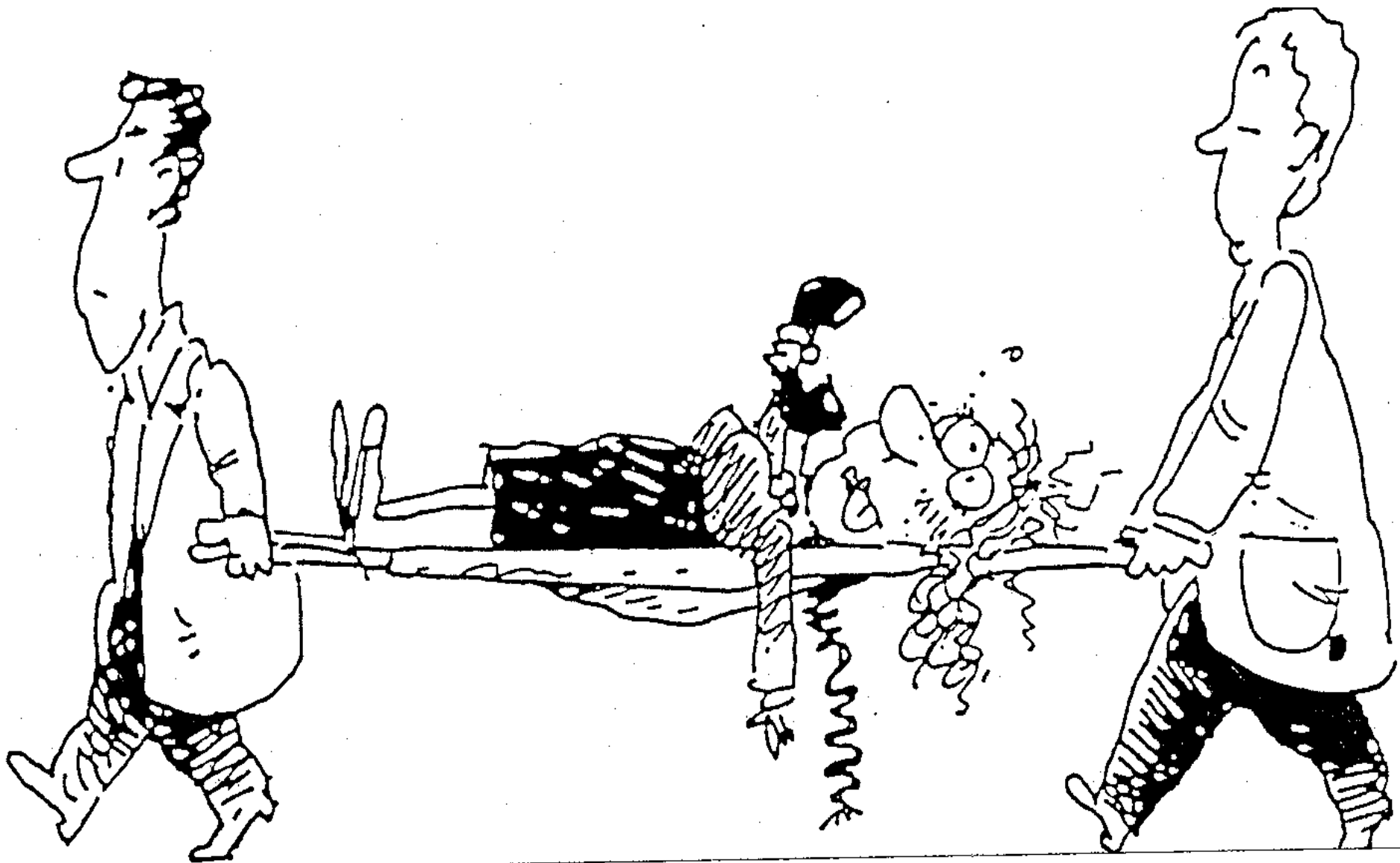


Summary

- Carbohydrates, grains and whole grains are recommended in dietary guidance around the world.
- Consumption of whole grain and grain foods in the right balance is associated with lower risks of diabetes, cardiovascular disease, stroke, certain cancers and all cause mortality.
 - They do not increase risk as alleged

Summary

- Real obesity cause = too many calories from all sources
- Gluten-free and grain-free diets are not necessarily healthier and are often less healthy.
 - Little evidence to support claims that we did not evolve to eat grains
- Grains and carbohydrate staples are needed to help feed the world by 2015.



We need to convince consumers it's something they're not eating?



Whole-grains contain more fibre, vitamins, minerals and phytochemicals (plant substances) than refined grains. For example, the vitamin content of brown rice is about 5-10 times higher than white rice.

The beneficial components in whole-grains work together to lower your risk of heart disease and diabetes. Fibre helps to reduce 'bad' cholesterol and regulate blood sugar levels. Some of the vitamins, minerals and phytochemicals act as antioxidants to help protect against blocked arteries. Whole-grains may also support weight management as they help promote the feeling of fullness.

To learn more about whole-grains and try out delicious recipes, visit www.hpb.gov.sg/foodforhealth

Have 2-3 servings of whole-grains daily in place of foods made from refined grains.

Examples of 1 serving are ½ bowl of brown rice or 2 slices of wholemeal bread.

Whole-grain products include:



Brown rice Wholemeal bread Brown rice, pastas and wholemeal pasta Oats and whole-grain breakfast cereals