OPTIMAL DIETS FOR PREVENTION OF CHD AND TYPE 2 DIABETES MELLITUS

Frank B. Hu M.D., Ph.D.

Associate Professor of Nutrition and Epidemiology
Harvard School of Public Health

The Search for Optimum Nutrition

- ***Medicine and Food are of the Same Source***
  --- Neijing, The Yellow Emperor's Classic of Internal Medicine

- ***Let Food be thy medicine and medicine be thy food***
  --- Hippocrates circa 431 B.C.

What is the Optimal Diet?

Cover of following books:

Ornish, D. *Reversing Heart Disease*. Ballantine Books, 1992. ISBN: 0345373537.

Atkins, RC. *Dr. Atkins' New Diet Revolution*. Avon Books, 2001. ISBN: 006001203X.

Cover of *TIME* Magazine. Nash, J. Madeleine. What Really Makes You Fat? September 2, 2002.

Framing the Controversy:

Cover of *The New York Times Magazine*. Taubes, Gary. What if Fat Doesn't Make You Fat? July 7, 2002.

Prevalence of Diabetes

- Estimated prevalence in the United States*
  - 17 million people (6.2%)
    - 11.1 million diagnosed
    - 5.9 million undiagnosed
  - ≤20 years old = 151,000 (0.19%†)
  - ≥20 years old = 16.9 million (8.6%†)
  - ≥65 years old = 7.0 million (20.1%†)
- Estimated prevalence worldwide‡
  - 124 million people (2.1%)
    - 97% with type 2 diabetes

***In 2000 †Percentage in age group ‡In 1997**

CDC. National Diabetes Fact Sheet. 2002.
Amos AF, et al. Diab Med. 1997;14:S1-S85.

www.hypertensiononline.org

Prevalence of Diabetes

The Centers for Disease Control and Prevention (CDC) has compiled data on diabetes in the United States obtained from several surveys, including the National Health Interview Survey (NHIS), the Third National Health and Nutrition Examination Survey (NHANES III), the National Hospital Discharge Survey, and surveys conducted through the Behavioral Risk Factor Surveillance System (BRFSS). Based on data from these sources, the CDC estimates that 17 million people, or 6.2% of the population, had diabetes in 2000. A third of these cases were undiagnosed. Almost 9% of people ≥20 years old and 20.1% of people ≥65 years old had diabetes.

The estimated worldwide prevalence of diabetes in 1997, derived from World Health Organization (WHO) data, was 124 million people, with the majority (97%) having type 2 diabetes. According to the same projections, the number of people with diabetes is expected to increase to 221 million in 2010. Other less conservative projections by King et al used WHO data combined with demographic estimates and projections issued by the United Nations to place the number of people worldwide with diabetes at 135.3 million in 1995 and 300 million in 2025.

References:

The Centers for Disease Control and Prevention. National diabetes fact sheet: general information and national estimates on diabetes in the United States, 2000. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2002.

Amos AF, McCarty DJ, Zimmet P. The rising global burden of diabetes and its complications: estimates and projections to the year 2010. Diabet Med. 1997;14:S7-S85.

Estimates of Diabetes Prevalence in World Regions

Please see World Health Organization Report (WHO). Geneva, 1997. http://www.hypertensiononline.org/

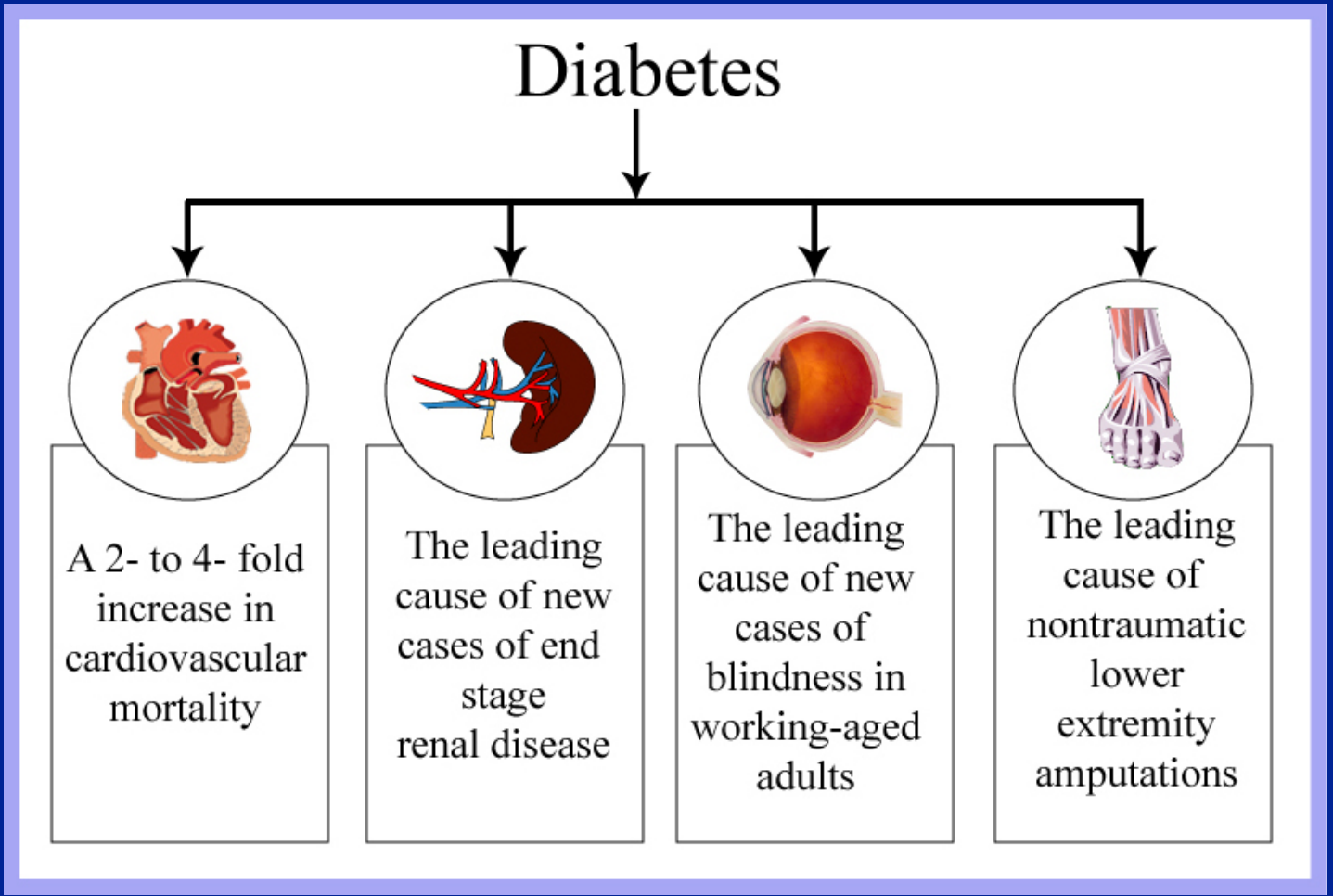
Estimates of Diabetes Prevalence in World Regions
Projections by King et al derived from World Health Organization (WHO) data combined with demographic estimates and projections issued by the United Nations place the number of people with diabetes worldwide at 135.3 million in 1995, 221 million in 2010, and 300 million in 2025. The greatest increases in cases of diabetes were projected to occur between 1995 and 2025 in the Americas (from 30.7 to 63.5 million), the Eastern Mediterranean (from 13.8 to 42.8 million), Southeast Asia (from 27.6 to 79.5 million), and the Western Pacific (from 26.4 to 56 million).

References:
The World Health Report 1997. Conquering suffering, enriching humanity. Geneva: World Health Organization. 1997.
King H, Aubert RE, Herman WH. Global burden of diabetes, 1995-2025: prevalence, numerical estimates, and projections. Diabetes Care. 1998;21(9):1414-1431.

Please see Mokdad, AH, et al. *Diabetes Care*. 2000;23(9):1278-1283.

Please see Mokdad AH, et al. *JAMA*. 2001;286(10)1195-1200.

Clinical Impact of Diabetes Mellitus



Multivariate Relative Risk of Fatal CHD in Women*

Please see Hu FB, et al. *Arch Intern Med*. 2001;161:1717-1723.

www.hypertensiononline.org

Multivariate Relative Risk of Fatal CHD in Women
This study involved a prospective analysis of the impact of type 2 diabetes and history of prior CHD on mortality in 121,046 women aged 30 to 55 with type 2 diabetes in the Nurses' Health Study. Among this cohort, the risk of CHD mortality increased monotonically with increased duration of diabetes.The age-adjusted relative risks of fatal CHD increased from 2.75 to 11.9 in women with diabetes for 5 or fewer years compared to those with diabetes for more than 25 years, respectively (P<0.001 for trend). The relative risk of fatal CHD for those with prior CHD compared to those without prior CHD was 5.29.

Reference:
Hu FB, Stampfer MJ, Solomon CG, Liu S, Willett WC, Speizer FE, Nathan DM, Manson JE. The impact of diabetes mellitus on mortality from all causes and coronary heart disease in women: 20 years of follow-up. Arch Intern Med. 2001;161(14):1717-1723.

Please see figure 1 of Willett WC. Balancing life-style and genomics research for disease prevention. *Science*. 2002 Apr 26;296(5568):695-8.

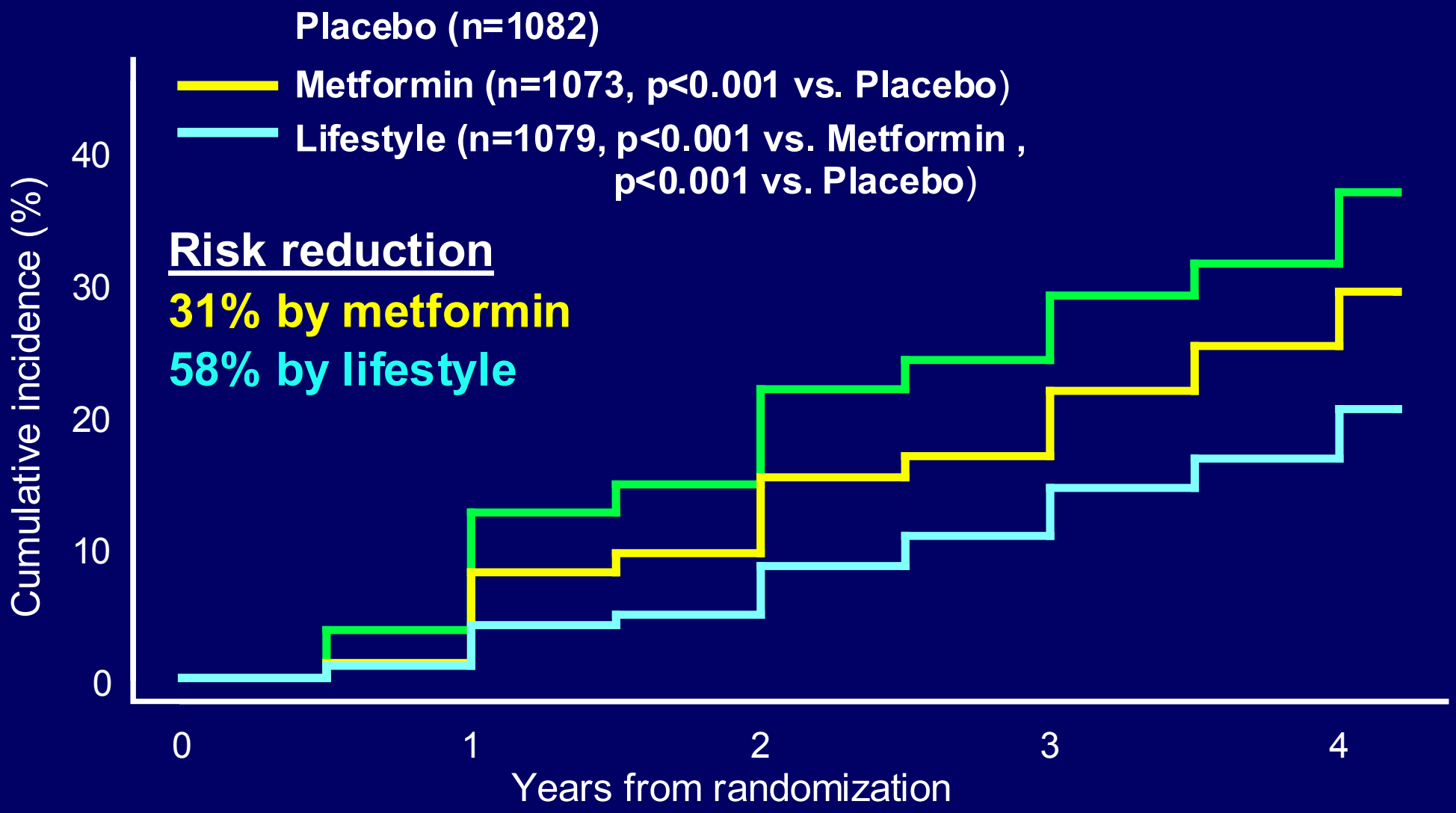
Percentage of colon cancer, stroke, coronary heart disease, and type 2 diabetes that is potentially preventable by life-style modifications (**Healthy diet, not overweight, exercise, not smoking, moderate alcohol**)

Please see Hu FB, et al. Diet, lifestyle, and the risk of type 2 diabetes mellitus in women. *N Engl J Med*. 2001 Sep 13;345(11):790-7.

Comment in:

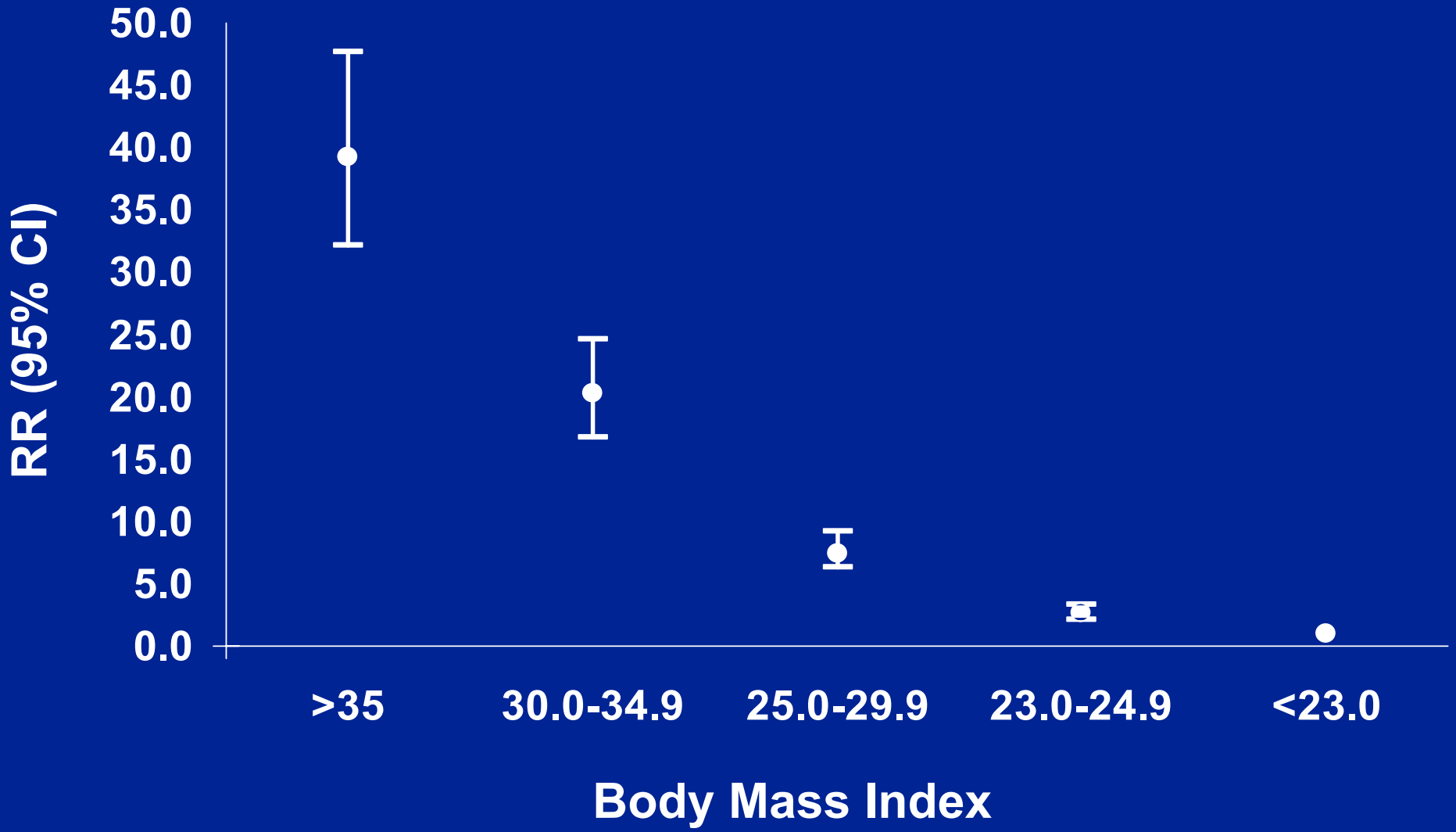
N Engl J Med. 2002 Jan 24;346(4):297-8.

Incidence of Diabetes



The DPP Research Group, *NEJM 346*:393-403, 2002

Body mass index



Hu et al. NEJM 2001

Key Research Issues in Diet and CHD/Diabetes

- Is the total fat recommendation scientifically sound? Should the 30% limit be abolished?
- Is a high-carbo diet really desirable?
  Is refined carbohydrate worse than saturated fat?
- How much and what kind of protein should we eat? Is a moderately high protein more healthy than we thought?
- Is the USDA food guide pyramid obsolete?

Hierarchy of Evidence

- **Randomized clinical trials with the disease as the outcome**
- **Prospective epidemiology with disease as the outcome**
- **Randomized trials with an established risk factor as the outcome, e.g. LDL**

… Case-control studies, ecological studies, animal studies, in vitro….

Assessing Causal Relationship (Hill criteria)

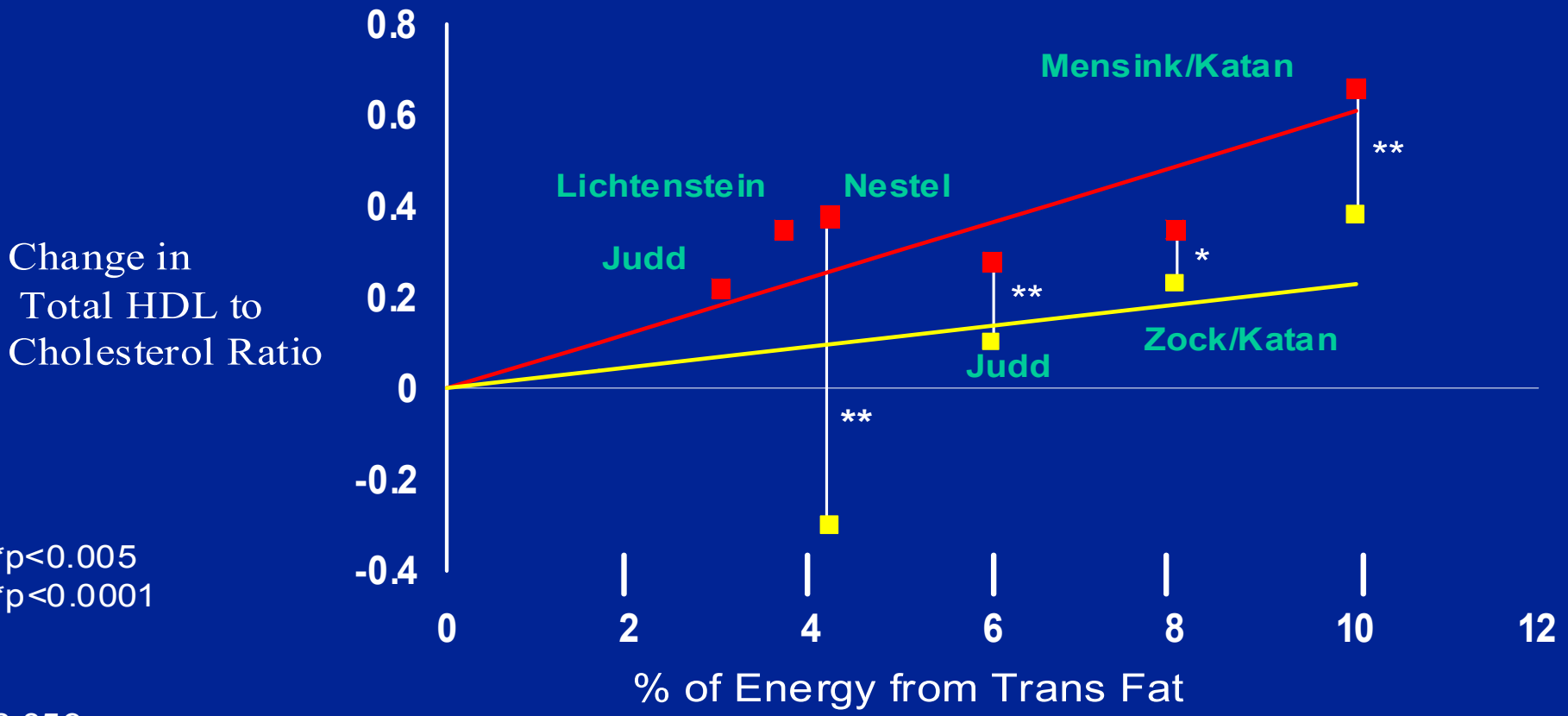
- Is there a valid statistical association?
  - rule out chance, bias, and confounding
- If yes,
  - Strength
  - Consistency
  - Biologic plausibility and gradient
  - Temporality
  - Experimental evidence

Although there is really no "hard-and-fast" rules for causal inference, convention are that the following be considered when assessing causal relation:

http://www.oldwayspt.org/pyramids/med/p_med.html

http://www.oldwayspt.org/pyramids/asian/p_asian.html

Change in Total HDL to Cholesterol Ratio



*p<0.005
**p<0.0001

8.059

Ascherio 1999

Please see Kennedy ET, et al. The Healthy Eating Index: design and applications. *J Am Diet Assoc*. 1995 Oct;95(10):1103-8.

Comment in:

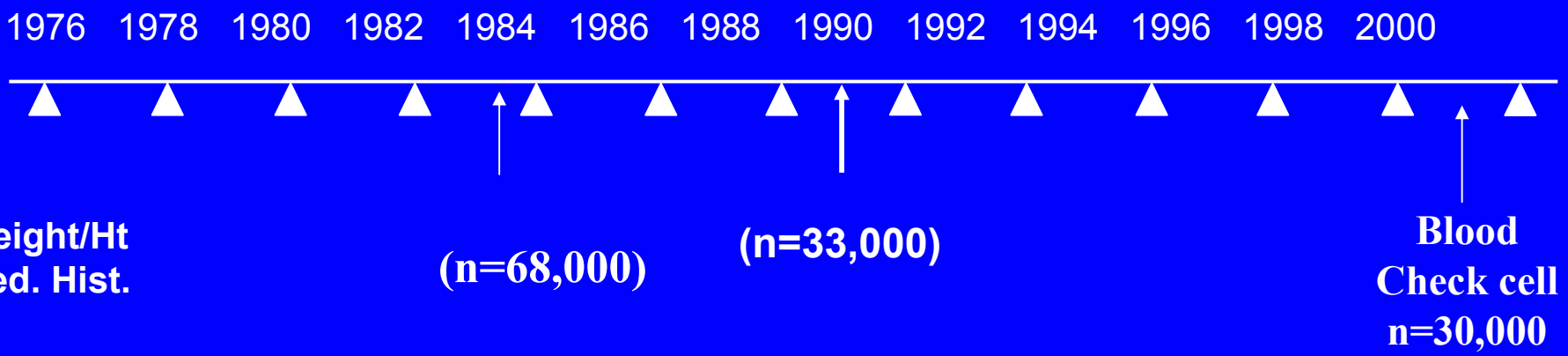
J Am Diet Assoc. 1996 Aug;96(8):751-2.

Please see Kennedy ET, et al. The Healthy Eating Index: design and applications. *J Am Diet Assoc*. 1995 Oct;95(10):1103-8.

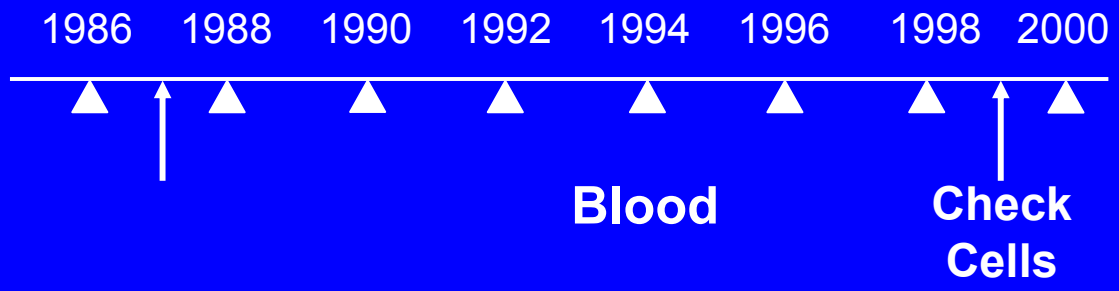
Comment in:

J Am Diet Assoc. 1996 Aug;96(8):751-2.

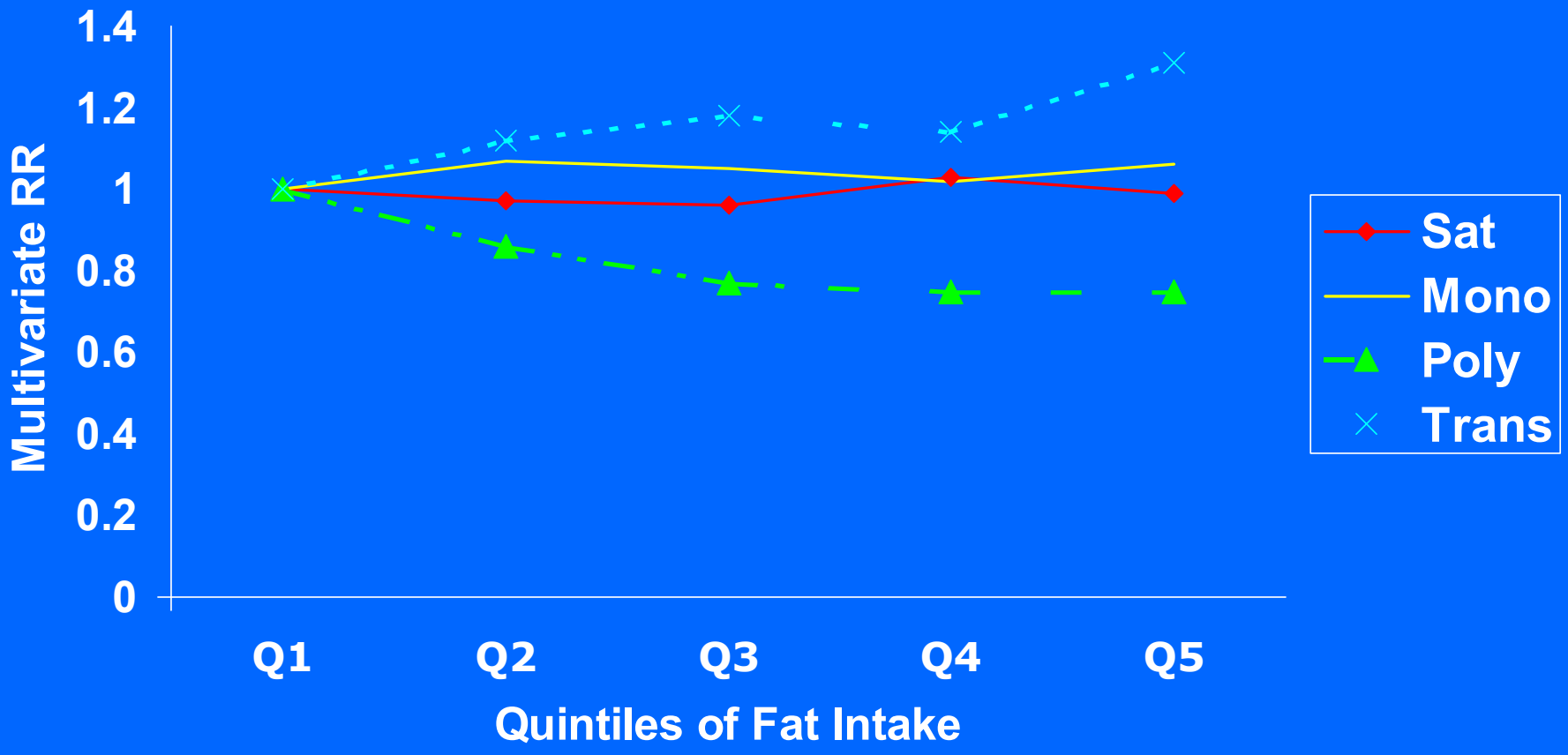
Nurses' Health Study (n=121,700)



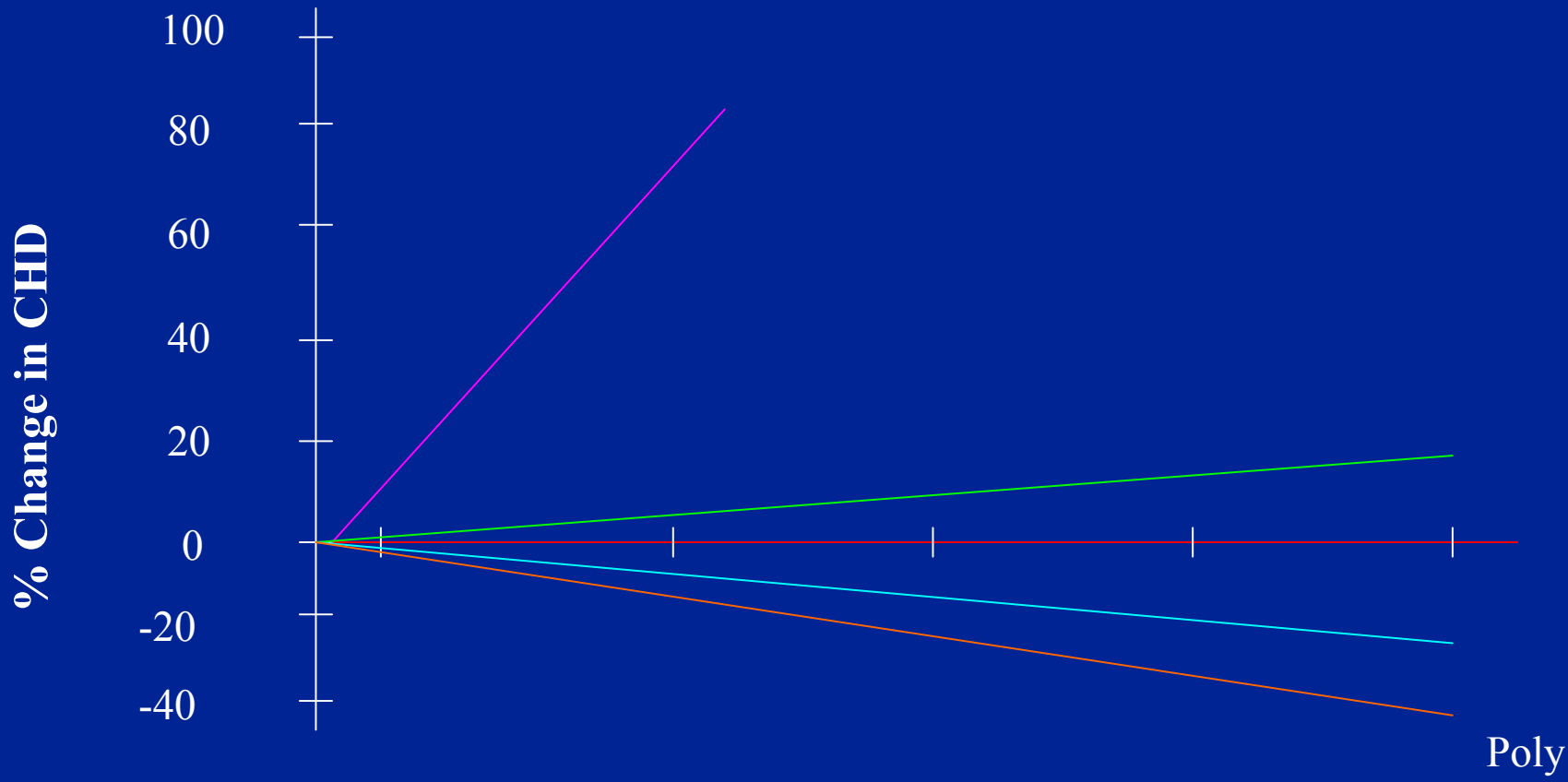
Health Professionals Follow-up Study (n=51,529)



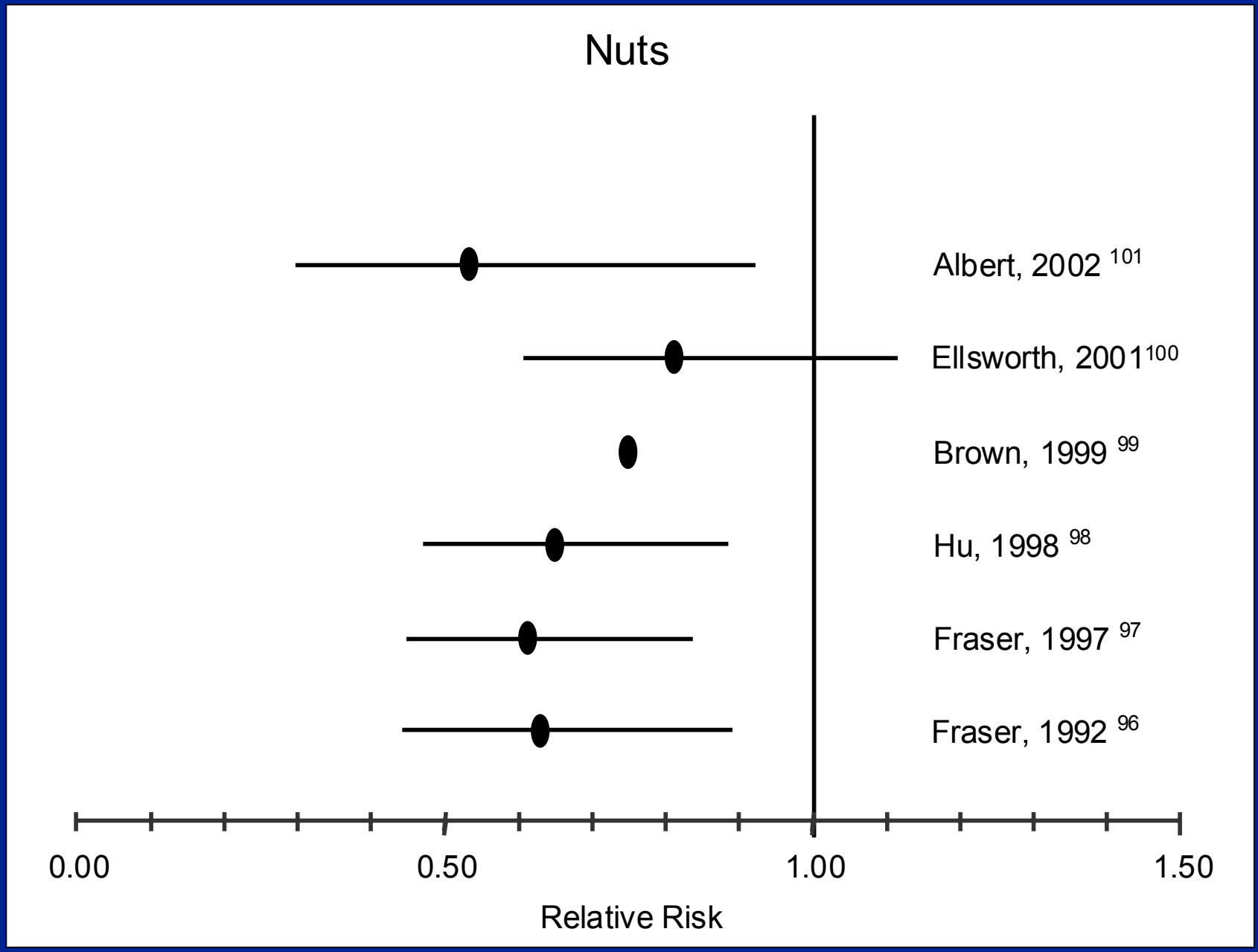
MV RRs of type 2 diabetes according to quintiles of specific types of dietary fat (mutually adjusted)



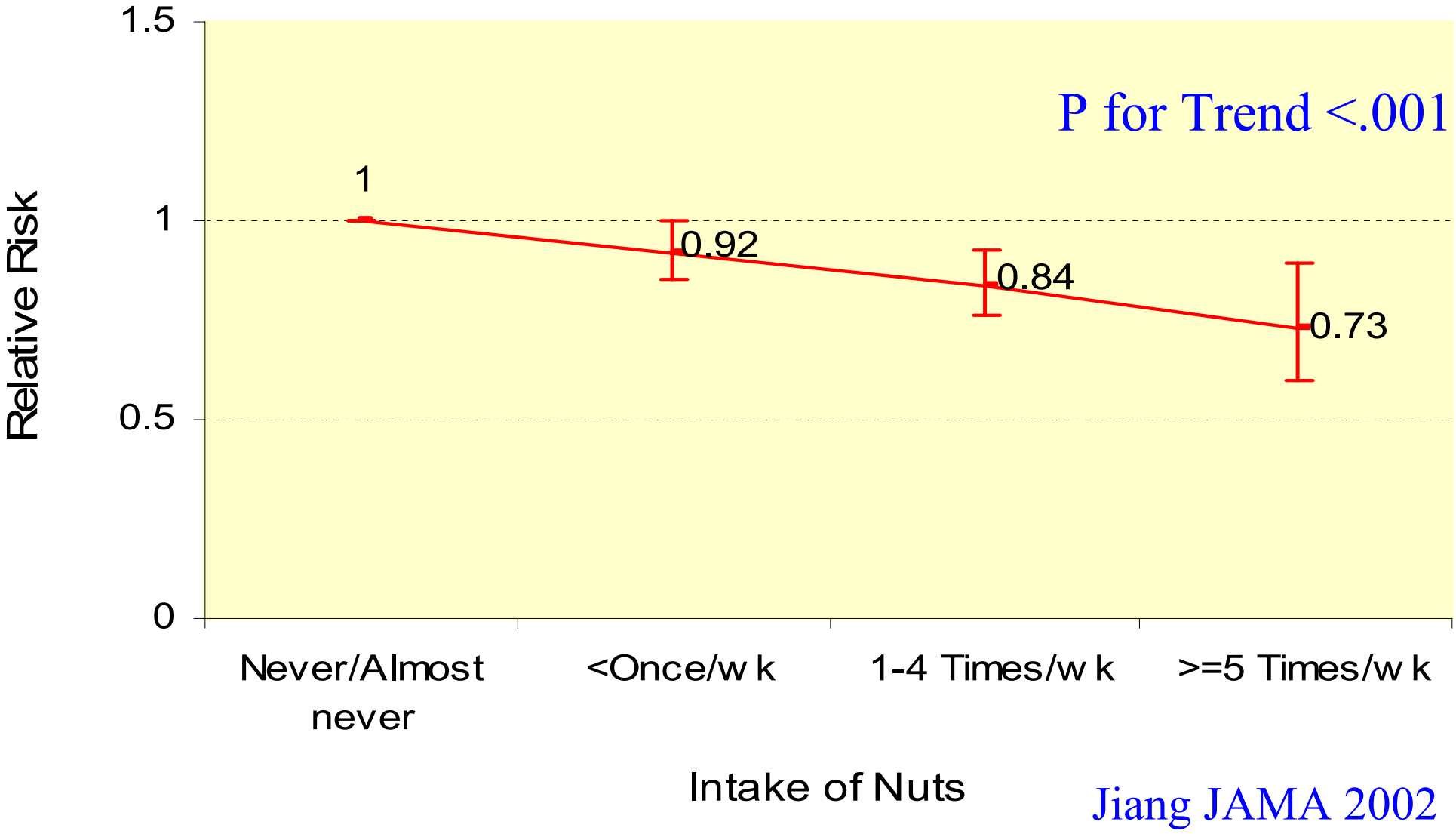
Salmeron 2001



Hu et al. NEJM 1997

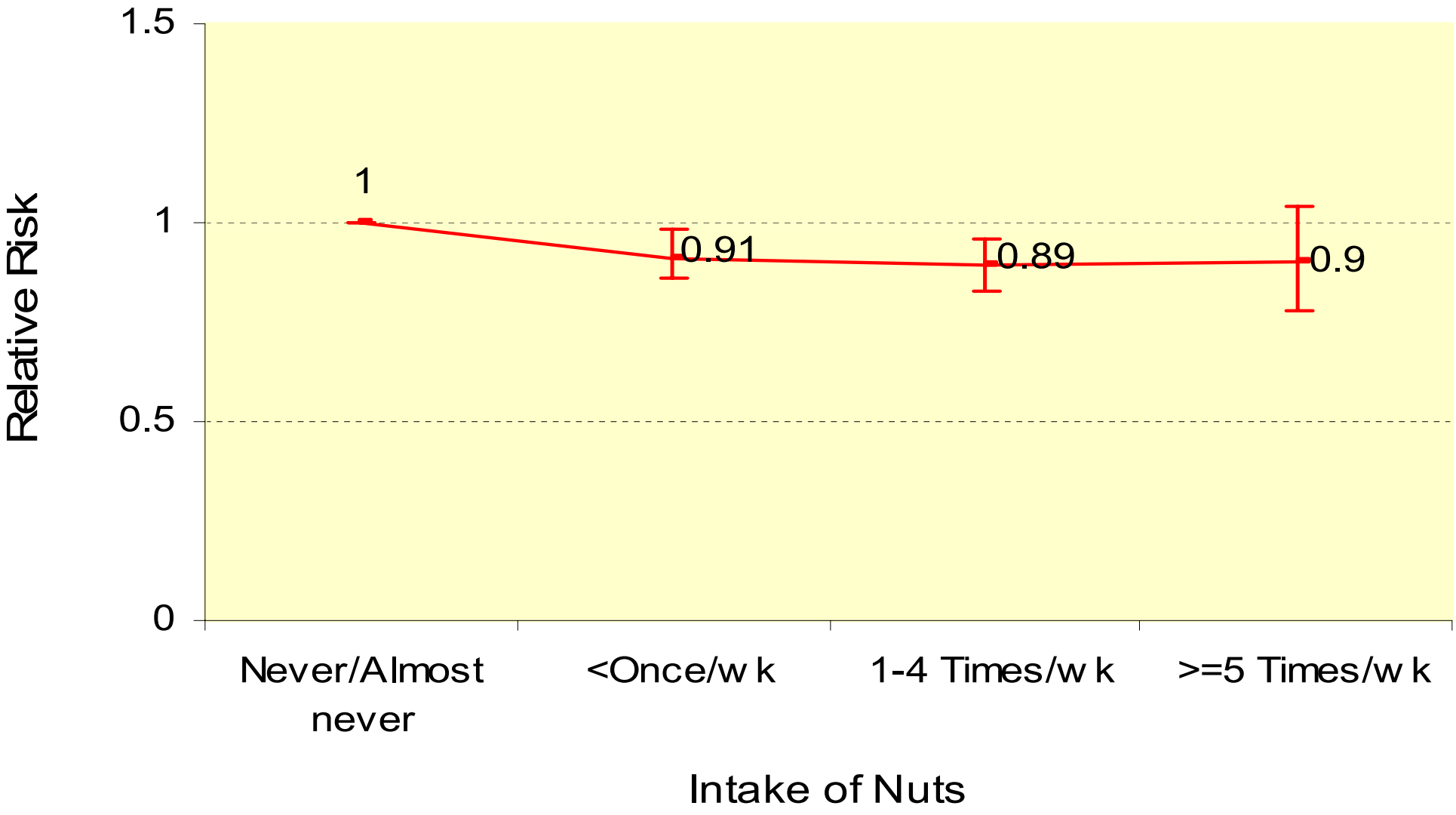

Nuts
Albert, 2002 101
Ellsworth, 2001100
Brown, 1999 99
Hu, 1998 98
Fraser, 1997 97
Fraser, 1992 96
0.00
0.50
1.00
1.50
Relative Risk

Nut Consumption and Reduced Risk of Type 2 Diabetes



Jiang JAMA 2002

Nut Consumption and Risk of Obesity (BMI≥30)



Dose Response of Almonds on CHD risk factors (Jenkins et al. Circulation 2002).

- 27 Hyperlipidemic subjects randomly assigned to 3 diets: full dose almonds (73 g), almonds+muffins, and full-dose muffins.

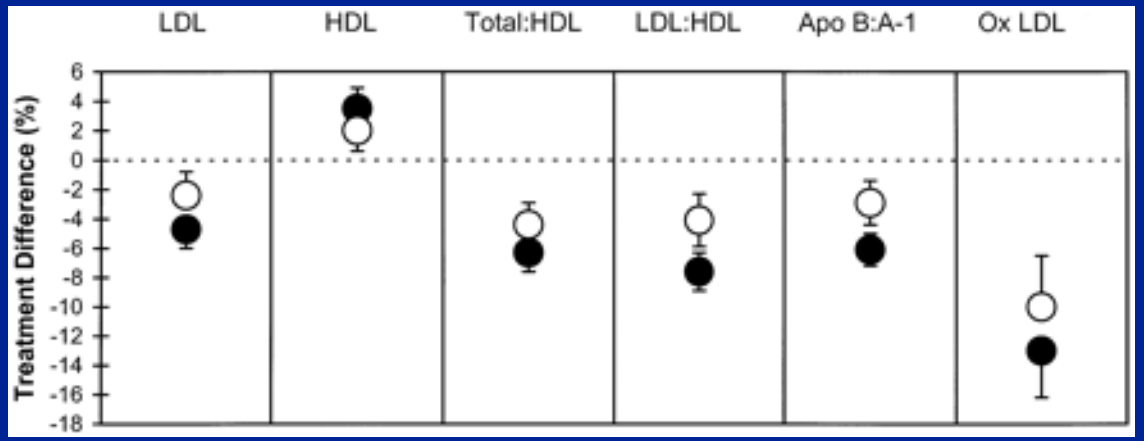


Table. Trials of Dietary Interventions and Coronary Events*

Trial	Patients in Intervention Group	Dietary Intervention	Dietary Fat (Energy) in Treatment Group, %	Energy From P and S Fat in Treatment Group, %	Overall Trial Duration, y	Change in Serum Cholesterol Level, %†	Change in CHD, %‡
Low-Fat Approach							
MRC (low fat)[52]	123 male MI patients	Reduce total fat	22	NR	3	−5	+4
DART[53]	1015 male MI patients	Reduce total fat	32	NR	2	−4	−9
High-Polyunsaturated-Fat Approach							
Finnish Mental Hospital Study[47]	676 men without CHD	Reduce saturated fat, increase polyunsaturated fat	35	P = 13; S = 9	6	−15	−44§
Los Angeles Veteran Study[46]	424 men; most had no evidence of existing CHD	Reduce saturated fat, increase polyunsaturated fat	40	P = 16; S = 9	8	−13§	−20 in CHD, −31§ in cardiovascular events
Oslo Diet-Heart Study[48,49]	206 male MI patients	Reduce saturated fat, increase polyunsaturated fat	39	P = 21; S = 9	5	−14§	−25§
MRC (soy oil)[50]	199 male MI patients	Reduce saturated fat, increase polyunsaturated fat	46	P:S ratio = 2	4	−15§	−12
Minnesota Coronary Survey[51]	4393 men and 4664 women	Reduce saturated fat, increase polyunsaturated fat	38	P = 15; S = 9	1‖	−14§	0
Increase Omega-3 Fatty Acid							
DART[53]	1015 male MI patients	Fish twice per week or fish oil (1.5 g/d)	NR	NR	2	NR	−16 in CHD events, −29§ in total mortality
GISSI-Prevenzione[66,67]	5666 MI patients, primarily men	Fish oil (EPA + DHA, 1 g/d)	NR	NR	3.5	0	−30§ in cardiovascular death, −45§ in sudden death
Indian Experiment of Infarct Survival 4[68]	242 MI patients, primarily men	Fish oil (EPA, 1.08 g/d) or mustard oil (ALA, 2.9 g/d)	NR	NR	1	0	−30§ in fish oil group, −19 in mustard oil group
Whole-Diet Approach							
Lyon Diet Heart Study[69,70]	302 MI patients, primarily men	High ALA intake and Mediterranean diet	31	P:S ratio = 0.7	3.8	0	−72§
Indian Experiment of Infarct Survival[117]	204 MI patients, primarily men	High intake of fruits, vegetables, nuts, fish, and pulses	24	P:S ratio = 1.2	1	−9§	−40§

*Adapted from Hu et al.[128] P indicates polyunsaturated fat; S, saturated fat; CHD, coronary heart disease; MRC, Medical Research Council; MI, myocardial infarction; NR, not reported; DART, Diet and Reinfarction Trial; GISSI, Gruppo Italiano per lo Studio della Sopravvivenza nell'Infarto Miocardico; EPA, eicosapentaenoic acid; DHA, docosahexaenoic acid; and ALA, α-linolenic acid.

†Change in cholesterol level refers to the percentage change in serum cholesterol level in the treatment group compared with the change in the control group.

‡Change in CHD refers to the percentage difference in coronary event rates in the treatment group compared with the control group.

§$P<.05$.

‖The total duration of the study was 4.5 years, but the mean duration of the intervention was only 1 year.

JAMA 2002

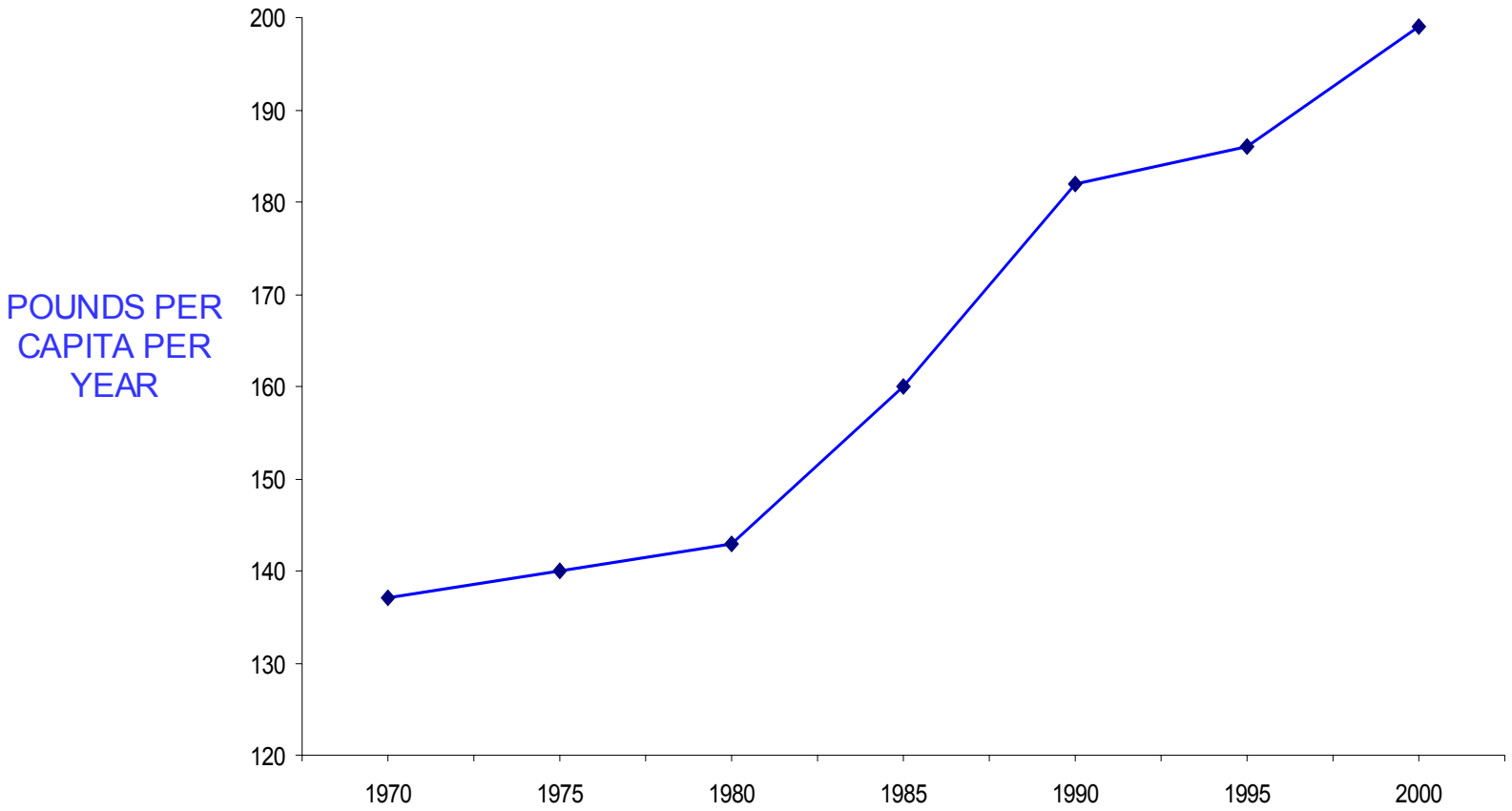
Summary of Clinical Trials

- Three approaches are effective in lowering risk of CHD:
  - Substitute polyunsaturated fat for saturated and trans fats.
  - Increase omega-3 fatty acids from fish or plant sources.
  - A dietary pattern higher in fruits, vegetables, whole grains, nuts, and fish.

Types of Carbohydrates

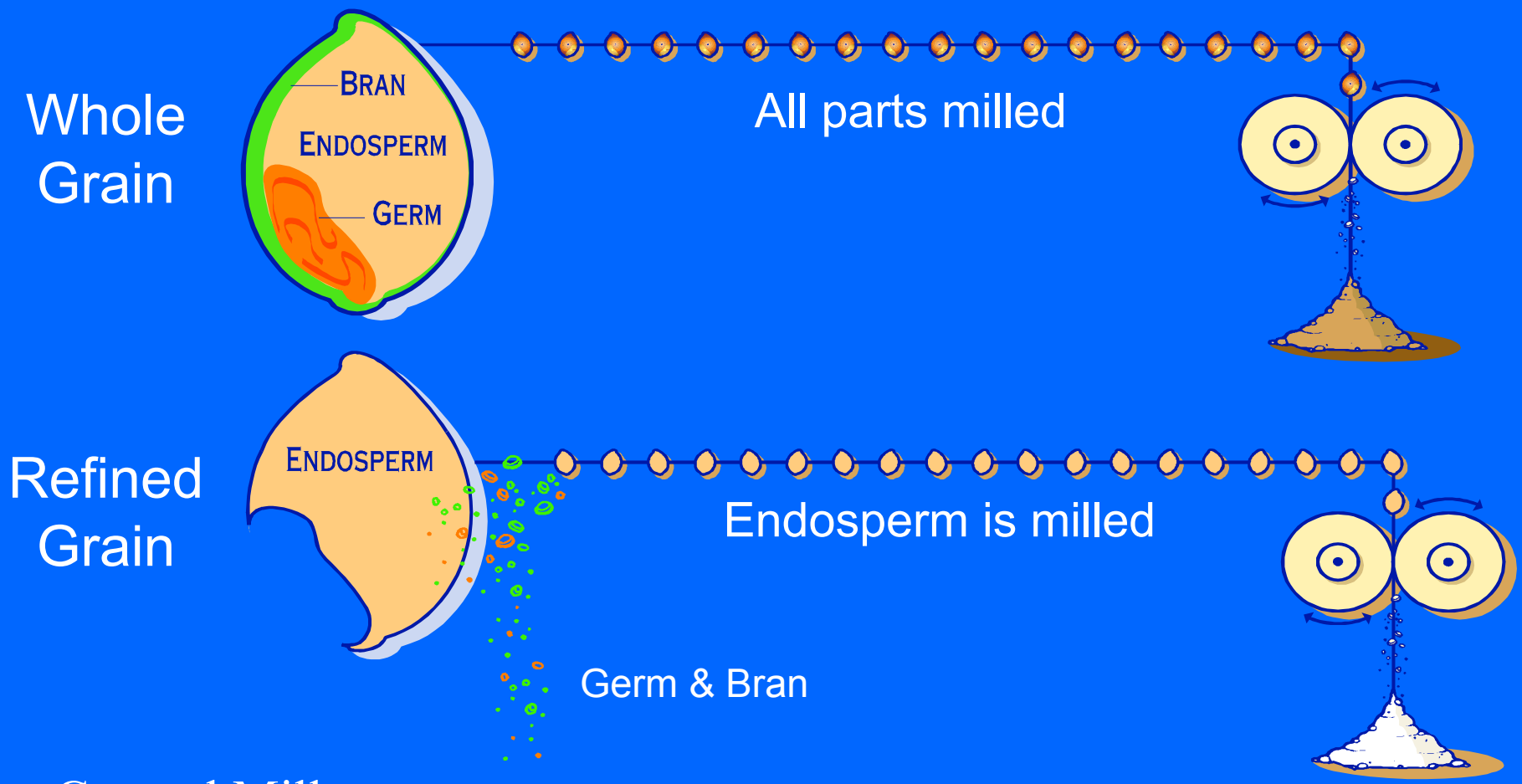
Is Refined Carbs Worse Than Saturated Fat?

FLOUR AND CEREAL PRODUCT CONSUMPTION



SOURCE: USDA/Economic Research Service

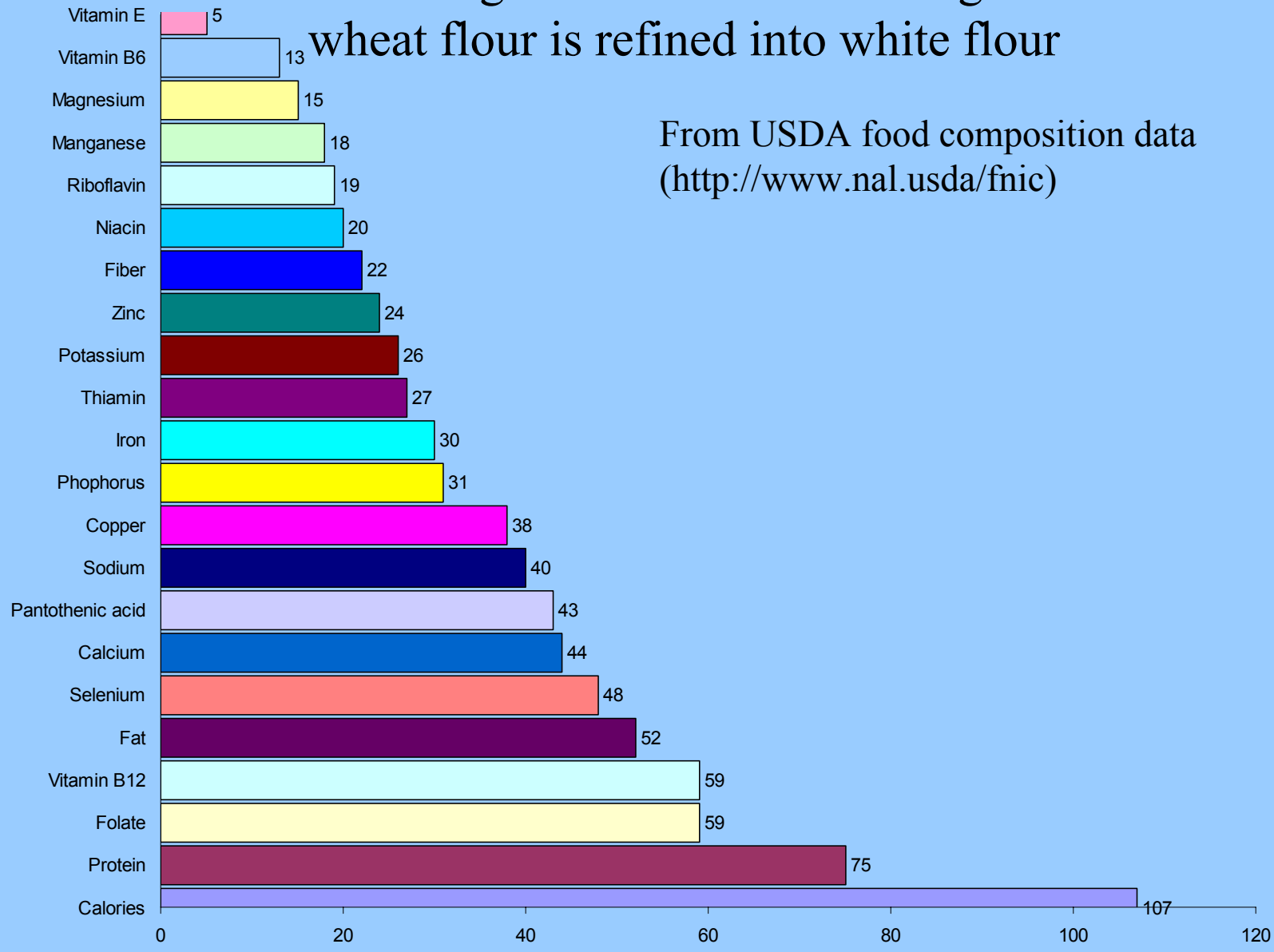
Milling of Grains



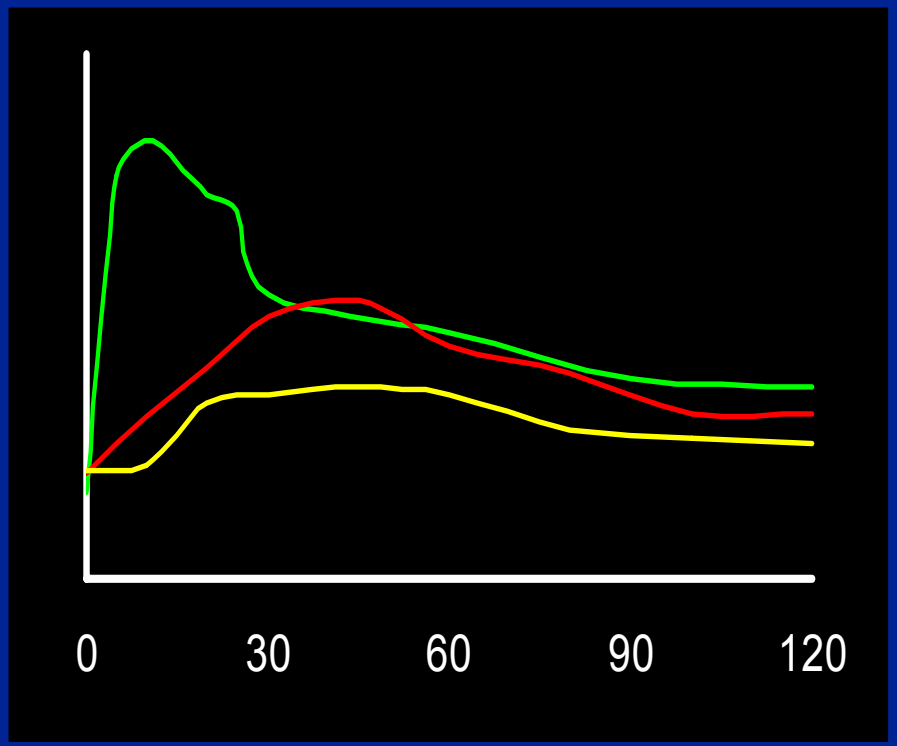
Source: General Mills

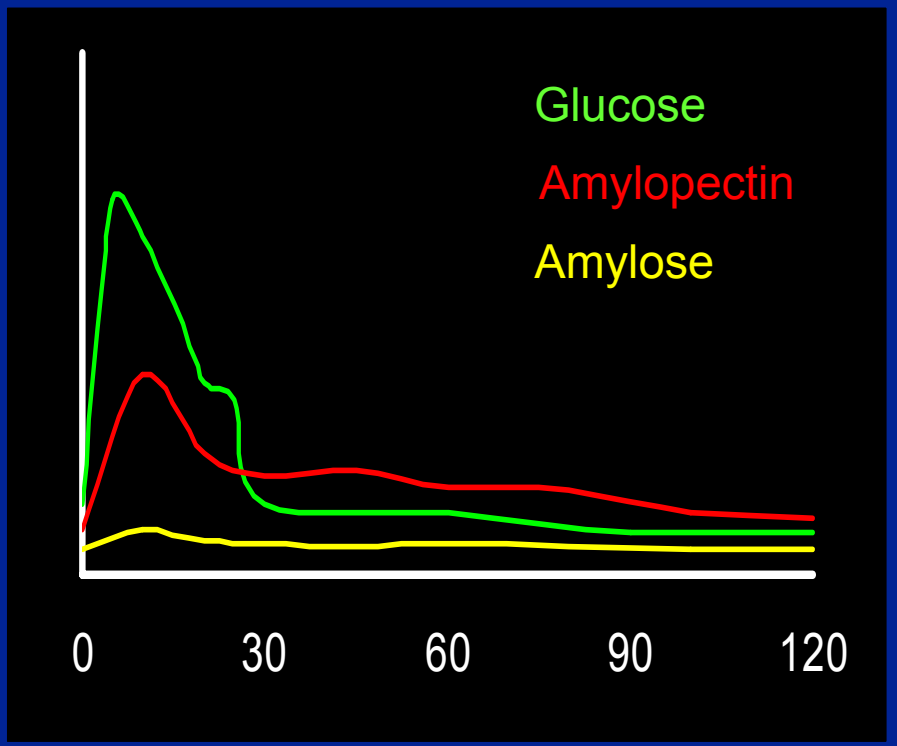
Percentage of nutrients remaining after whole wheat flour is refined into white flour

From USDA food composition data (http://www.nal.usda/fnic)



Postprandial Response

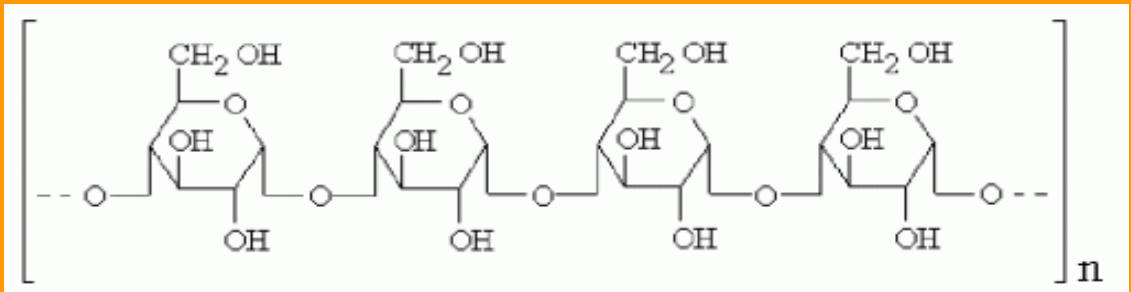




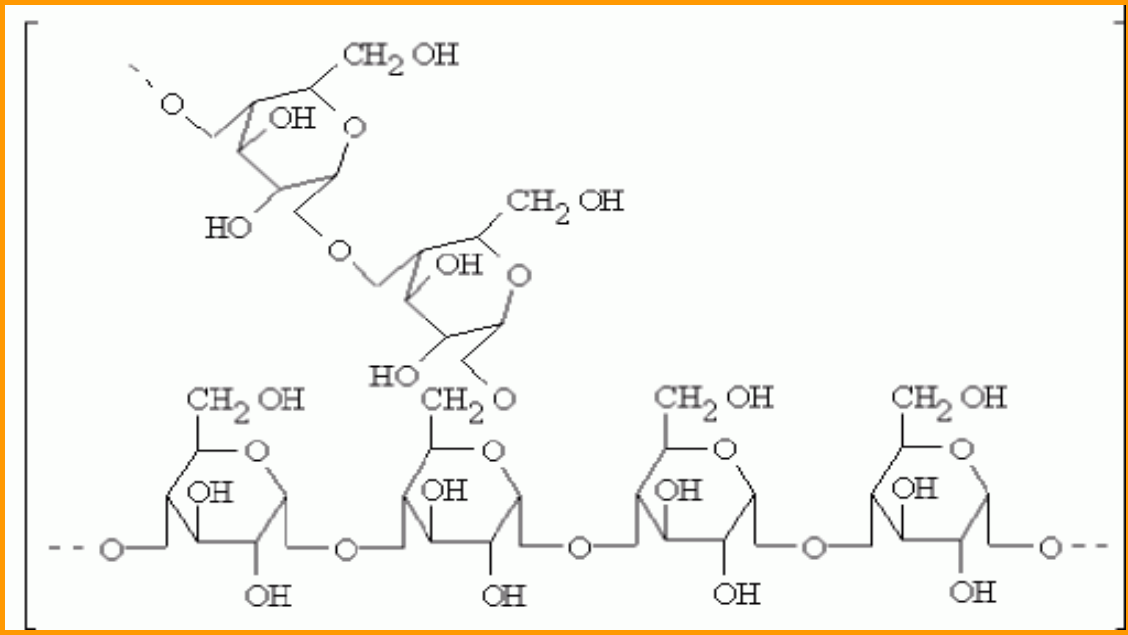
Time (minutes)

GLYCEMIC RESPONSE

INSULIN RESPONSE



Amylose

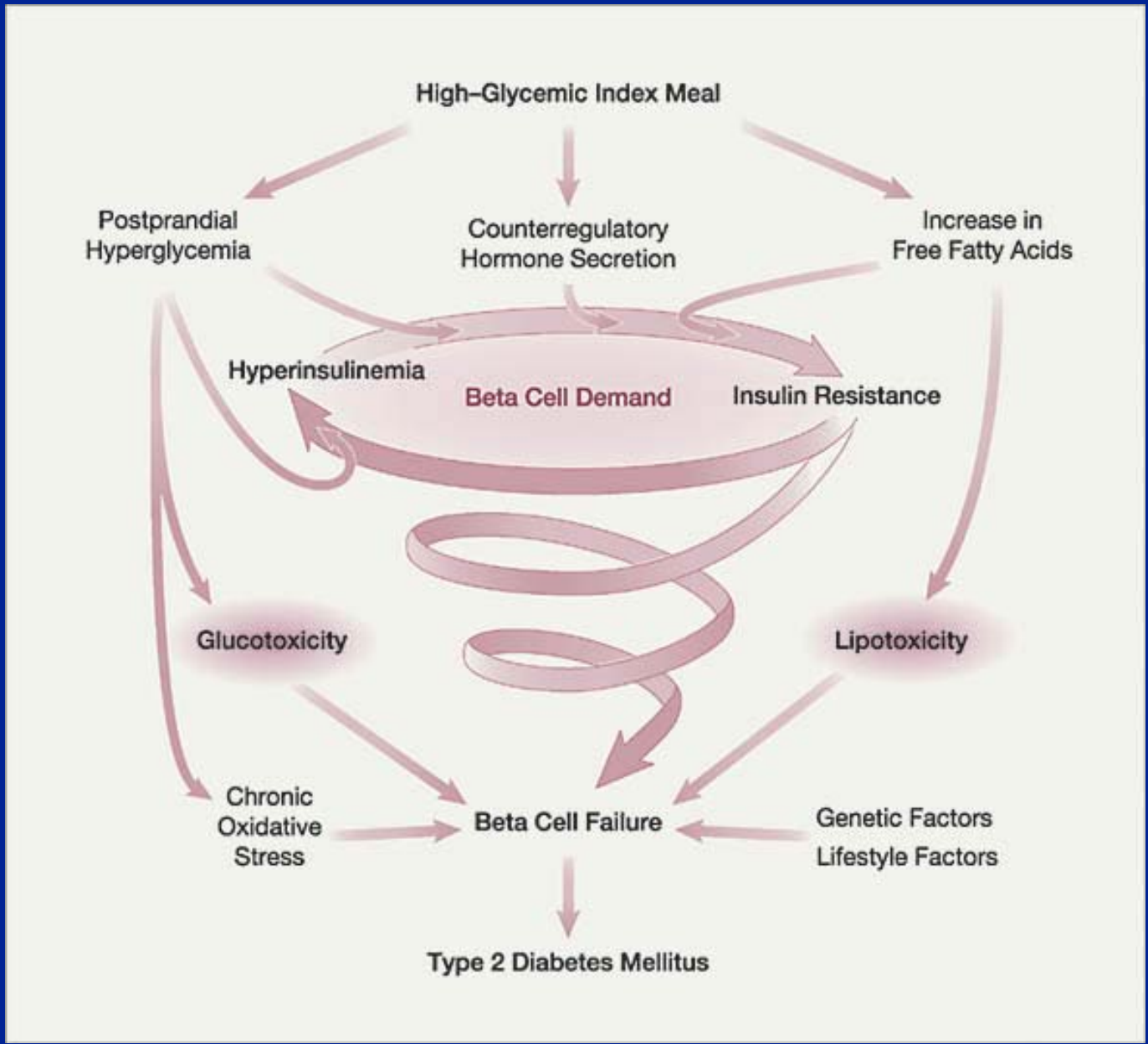


Amylopectin

Glycemic Load (GL)

$$GL = \sum GI_i \times CHO_i \times FPD_i$$

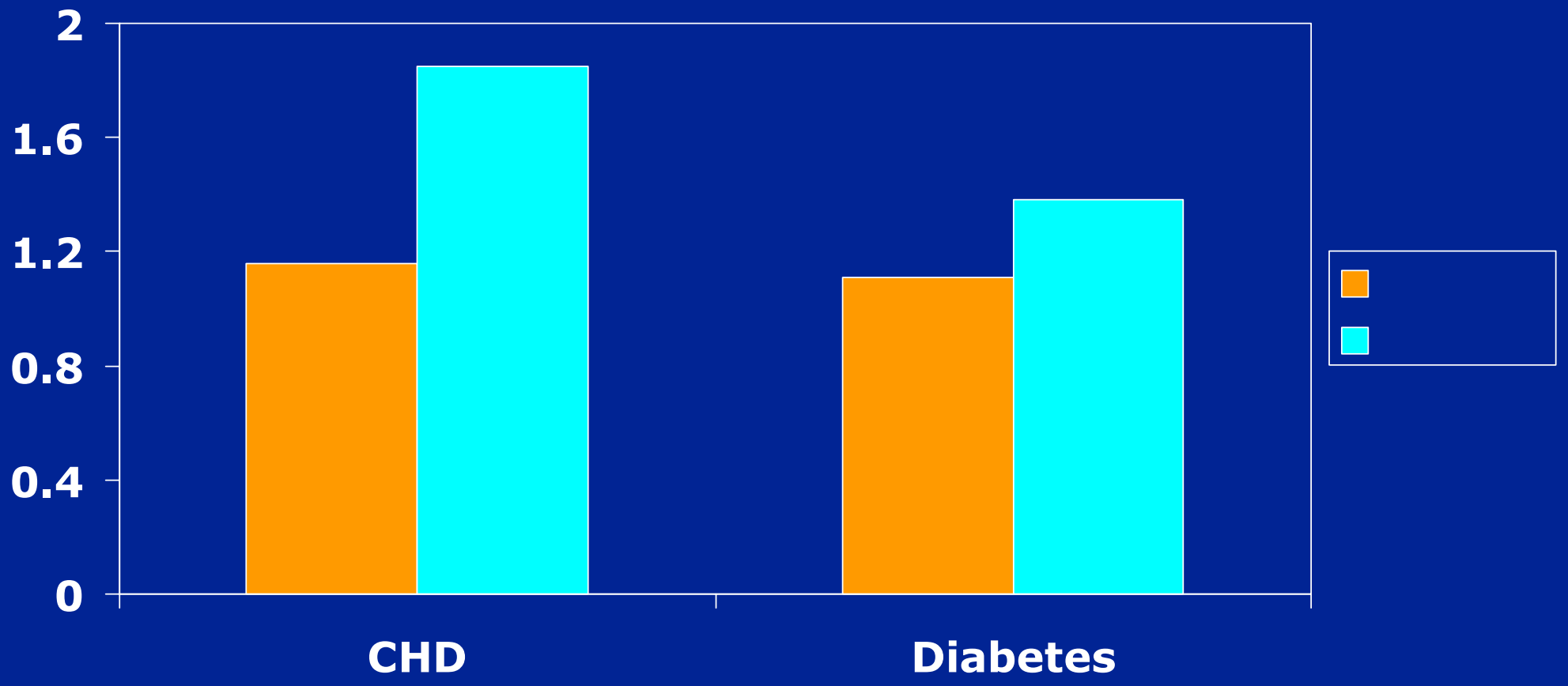
- GI_i = Glycemic index for food i
- CHO_i = grams of carbohydrate per serving of food i
- FPD_i = frequency of servings of food i per day during the past year
- Each unit of glycemic load represents the equivalent of one gram of carbohydrate from white bread



Ludwig, JAMA 2002

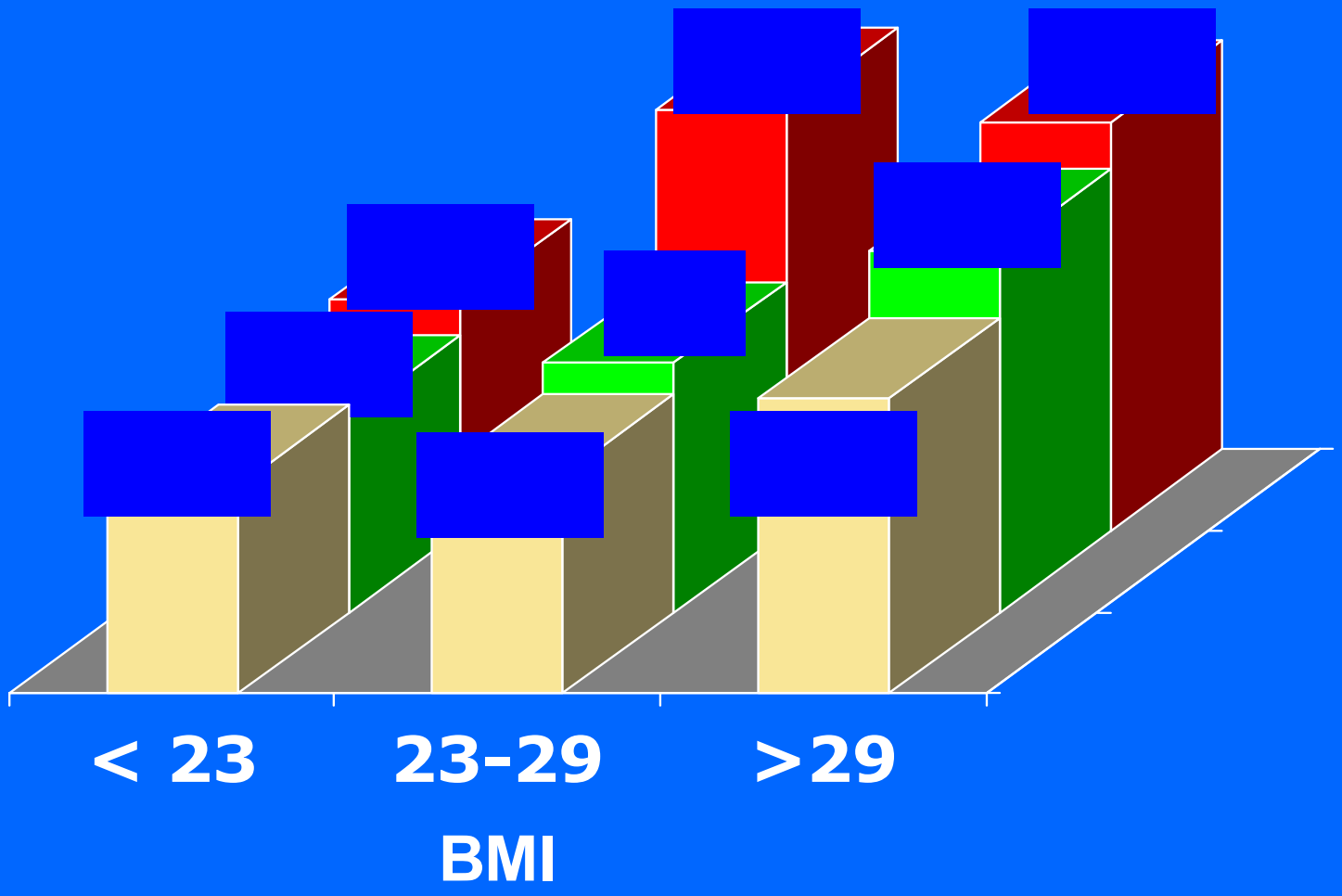
The hypothetical model relates a high–glycemic index diet to increased risk for type 2 DM.

Comparison of associations between saturated fat and glycemic load and risk of CHD and diabetes



Data from Hu 1997 NEJM, 2001 NEJM, Salmeron 2001 AJCN, Liu 1999 AJCN

Test for interaction, P < 0.01



Liu et al 2000

Should We Eat More Protein?

- Few Metabolic Studies on Protein and Blood Lipids
- Epidemiologic Studies are Limited
- Growing Interest in Protein and Satiety, Energy Expenditure, and Weight Loss
- Tremendous Interest in Soy Protein

The Effects of Substituting Animal Protein for Carbo

- 10 hypercholestrolemic subjects randomly assigned to high protein (23% E) and low-protein (11% E) diets for 4-5 wks then crossed over. HP diet ↓ LDL by 6%, ↓ TG by 23%, ↑ HDL by 12% (Wolfe, Metabolism 1991).

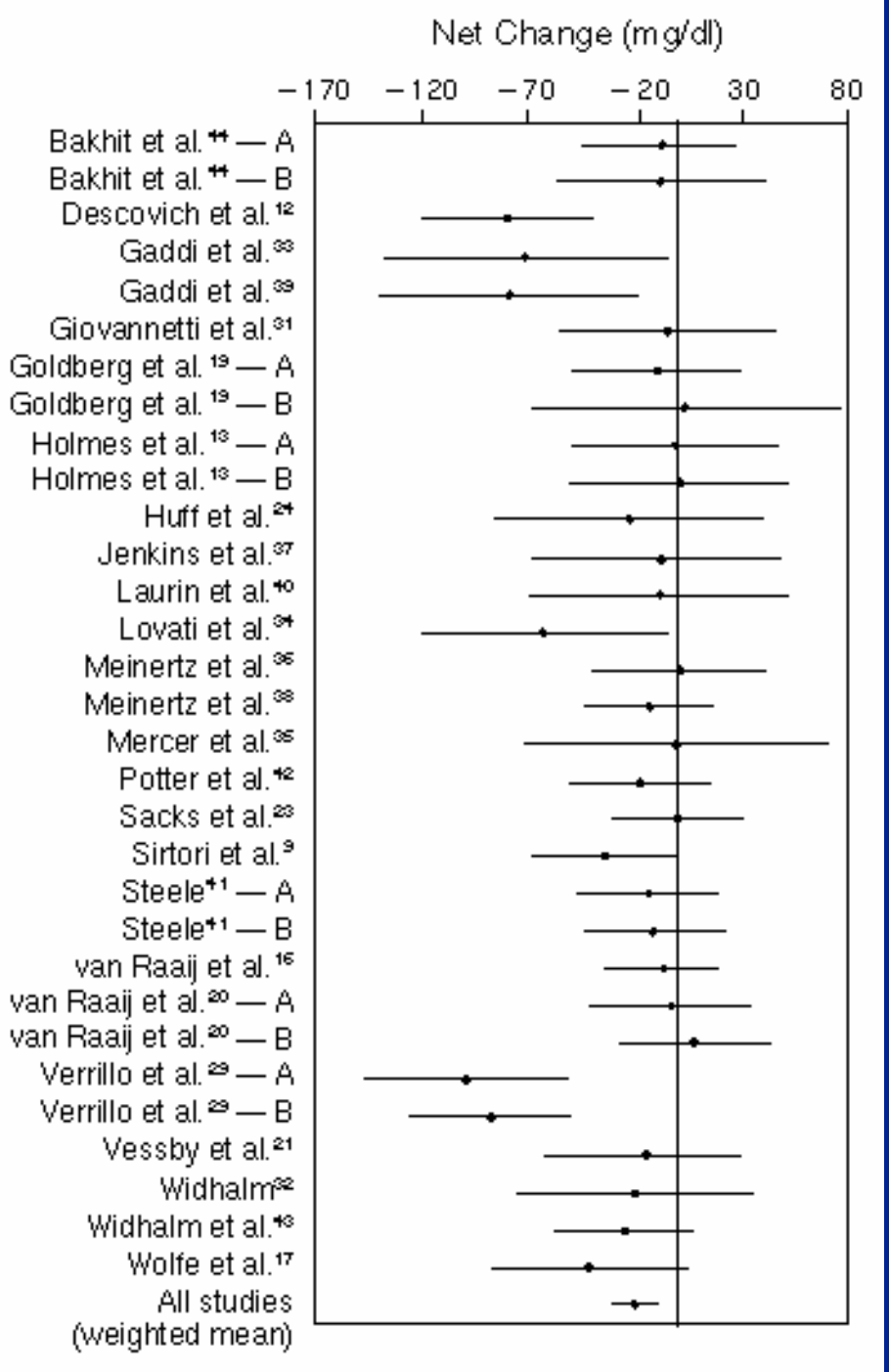
- 10 healthy normolipidemic subjects randomly assigned to high protein (22% E) and low protein (12% E) diets. HP diet ↓ LDL by 8%, ↓ TG by 27%, ↓ VLDL by 39%, ↑ HDL by 4% (Wolfe Clin Invest Med 1999).

The Effects of Substituting Plant Protein for Carbs (Jenkins et al. 2001 AJCN)

- 20 hyperlipidemic men and women in a randomized crossover design for 1 mo.
- 27% E from protein (starch replaced by wheat gluten) vs. 16% E from protein.
- High protein diet lowered serum TG by 19% ($p=0.003$), uric acid by 13% ($p<0.001$), creatinine by 2.5% ($p=0.035$), and LDL oxidation (the ratio of conjugated dienes to LDL cholesterol in the LDL fraction) by 11% ($p=0.009$).

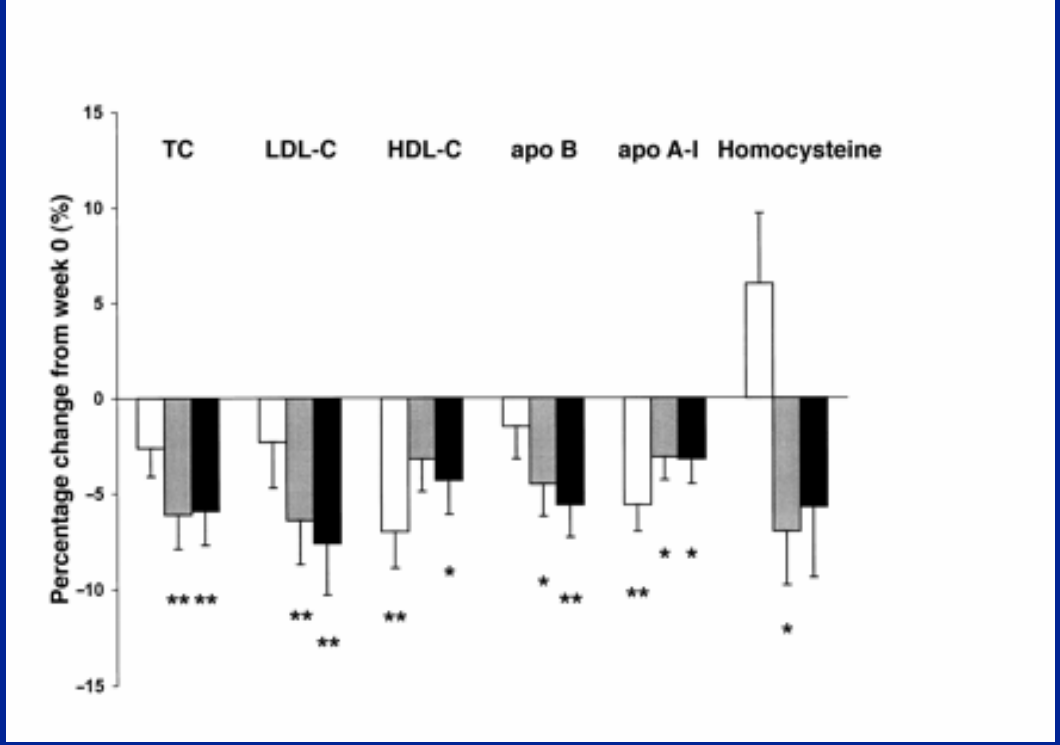
The effects of exchanging soy protein for animal protein on serum cholesterol (Anderson 1995, NEJM)

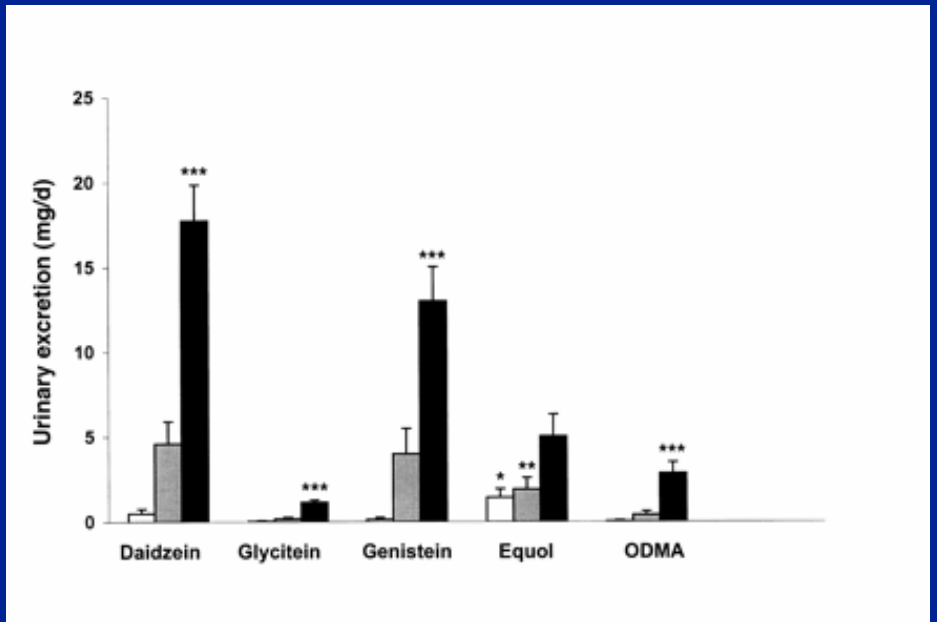
- The ingestion of 50 g of soy protein per day decreased serum cholesterol by 8%.
- 8 oz of soy milk contains 4 to 10 g of soy protein; 4 oz of tofu 8 to 13 g; 1 oz of soy flour, 10 to 13 g.



Effects of high- and low-isoflavone soyfoods on blood lipids, oxidized LDL, homocysteine, and blood pressure in hyperlipidemic men and women (Jenkins 2002, AJCN)

♦ 50 g soy protein and 73 mg isoflavones daily) vs. low- (52 g soy protein and 10 mg isoflavones daily) isoflavone soyfood diets.





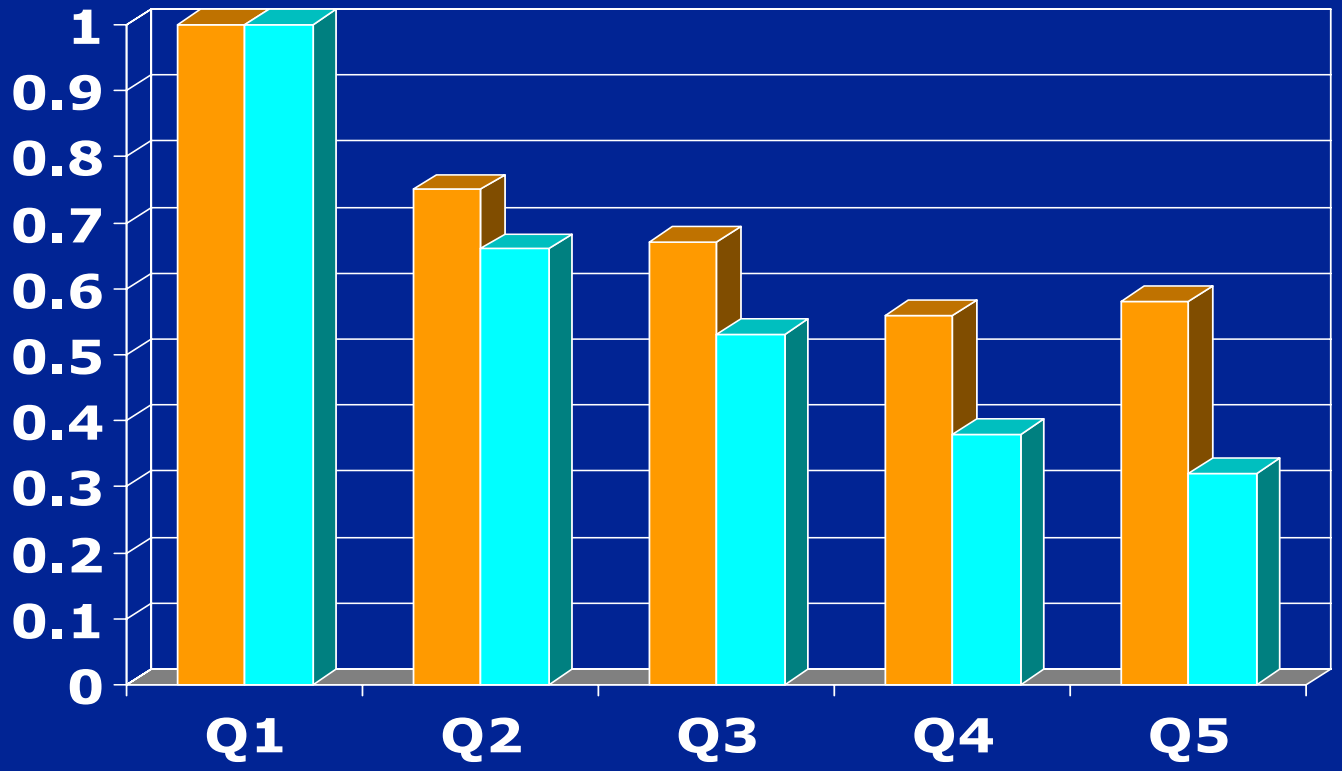
Relative Risks of CHD According to Quintiles of Protein intake

	Q1	Q2	Q3	Q4	Q5
Total protein (median % E)	15	17	19	21	24
Age Adj RR	1.0	0.82	0.81	0.86	0.75 (0.61-0.92)
MV RR1	1.0	0.86	0.84	0.91	0.72 (0.57-0.91)
MV RR2	1.0	0.86	0.84	0.92	0.74 (0.59-0.95)

RR1: Adj for nondietary covariates
RR2: Further adju for dietary fats

Hu 1999, AJCN

Animal protein and risk of hemorrhagic stroke



P for trend=0.04

Iso 2001, Circulation

Study	Animal Model	Design	Results
Yamori et al, 1981[33]	Stroke-prone, spontaneously hypertensive rat	High-protein + low-salt diet	Decreased stroke incidence
Yamori et al, 1984[34]	Stroke-prone, spontaneously hypertensive rat	High-protein diet	Decreased cerebral lesions
Sved, et al, 1979[35]	Spontaneously hypertensive rat	Intravenous tyrosine	Acute blood pressure decreased
Sved et al, 1982[36]	Spontaneously hypertensive rat	Intravenous tryptophan	Acute blood pressure decreased
Takemoto, 1991[37]	Renovascular hypertensive rat	Intracisternal γ-amino butyric acid (GABA)	Acute blood pressure decreased

Obarzanek et al. JAMA 1996

Protein and Body Weight

- Clinical trials of high protein diets on weight loss are typically small and inconclusive.
- Several studies tested ketogenic diets with varying amount of fat and protein. Thus, the independent effects of protein cannot be teased out.
  -- Sharman et al. 2002 J Nutrition
- Several recent studies have shown beneficial effects of high-protein diets on body weight and blood lipids, even with high saturated fat.
  -- Skov 1999 Int J Obesity
  -- Baba 1999 Int J Obesity
  -- Westman 2002 AHA

Randomized trial on protein vs. carbo with *ad libitum* energy intake (6 months)

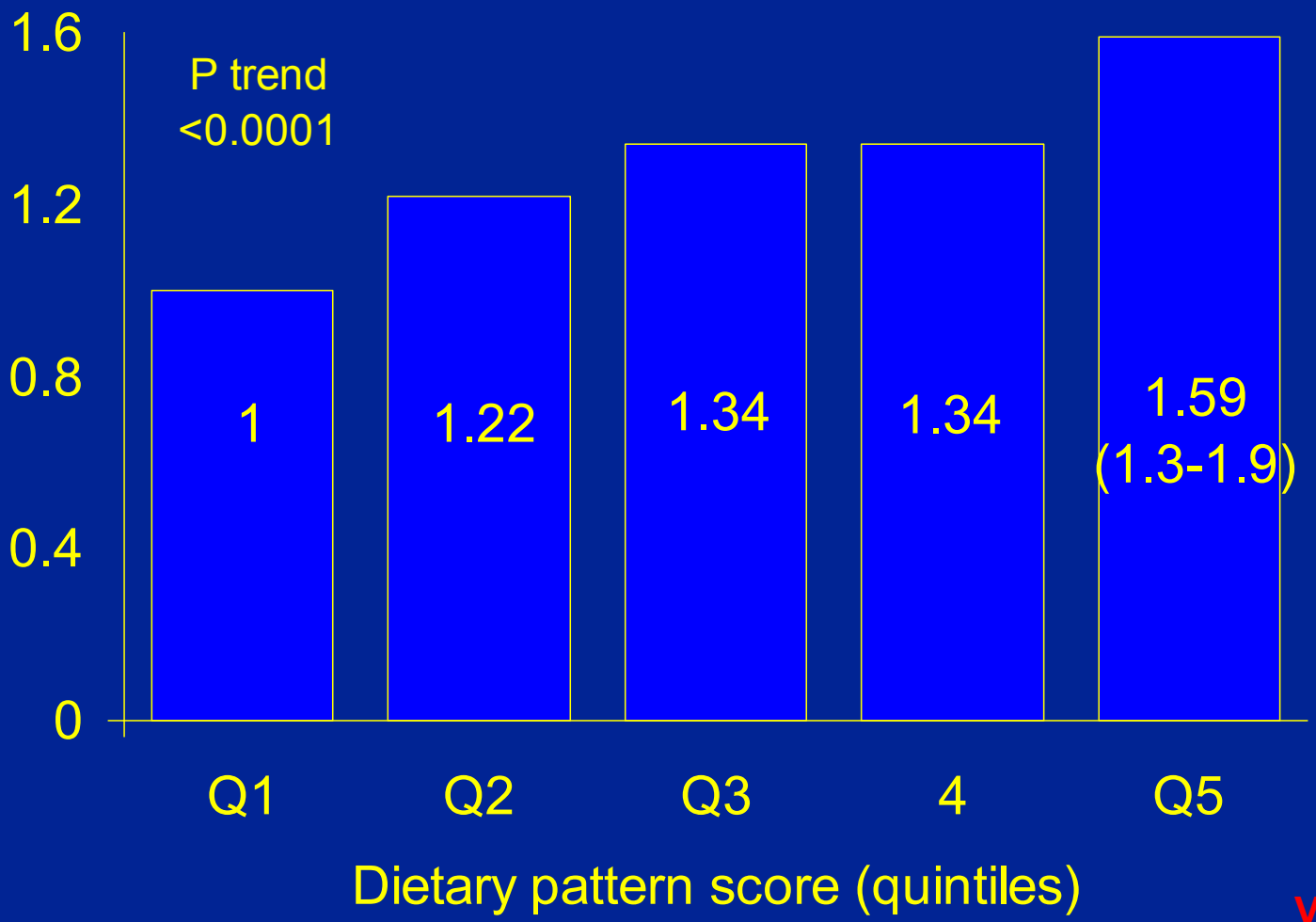
	High-Carbo	High-Protein
n	25	25
Diet	12% P, 58% C, 30% F	25% P, 45% C, 30% F
Average energy intake (kcal/d)	2605	2139*
Weight loss (kg)	5.1	8.9*
Fat loss (kg)	4.3	7.6*

Skov et al. Int J Obesity 1999

Changes in renal function with high vs. low protein diets

- A moderate high protein diet (25% E) did not change renal function (GFR/kidney volume) and urinary albumin or creatinine excretion (Skov et al. Int J Obesity 1999).
- A high protein diet (27% E total, 11% from wheat gluten) had no adverse effects on urine creatinine excretion (Jenkins et al. AJCN 2001).

‘Western’ pattern and relative risk of type 2 diabetes



Van Dam 2002
Ann Int Med

Relative Risk for Type 2 Diabetes in US Men by Physical Activity Level

www.hypertensiononline.org

Relative Risk for Type 2 Diabetes in US Men by Physical Activity Level

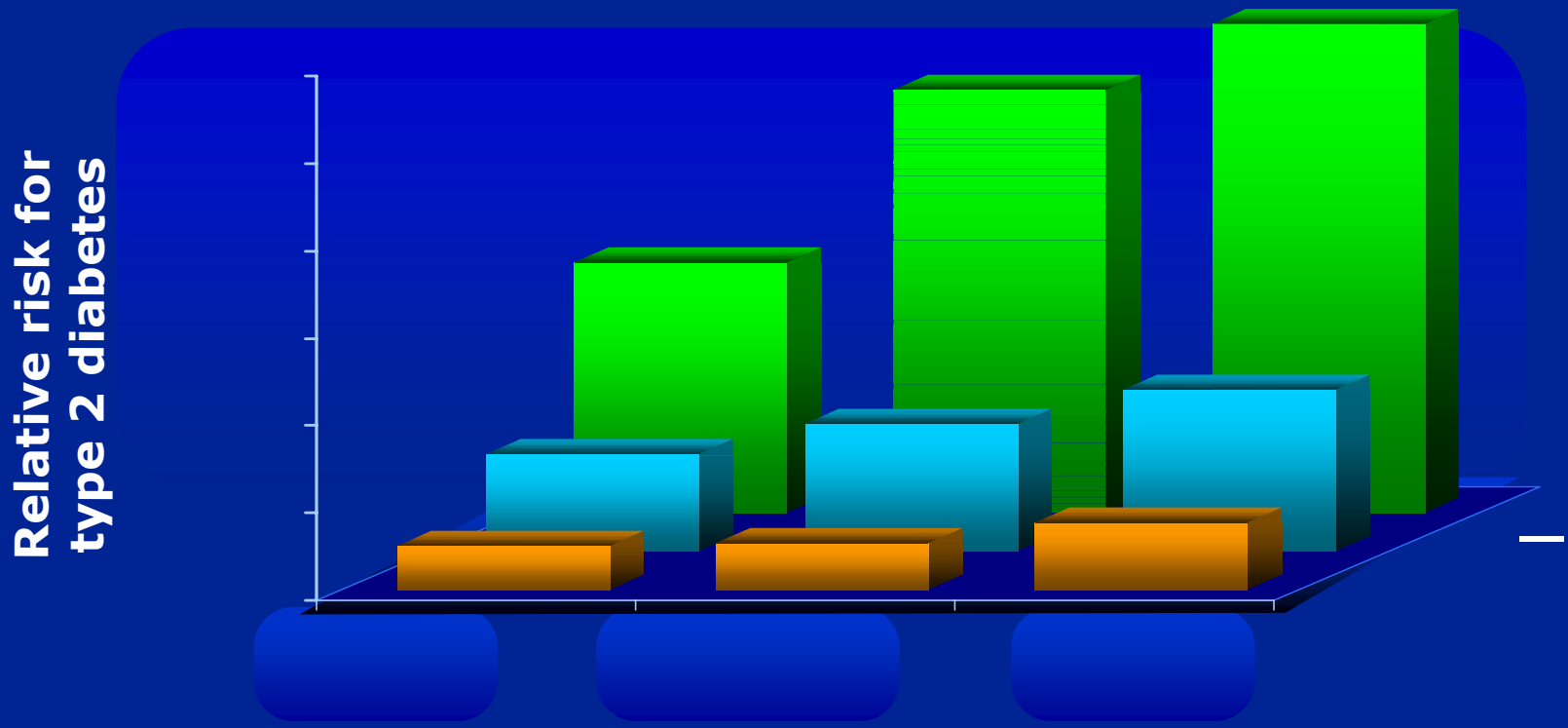
These data are from The Health Professionals Follow-up Study of 51,529 male health professionals. To assess dietary patterns, a 131-item food-frequency questionnaire was administered in 1986, 1990, and 1994. Using factor analysis based on data from these questionnaires, two major dietary patterns, "prudent" and "western", were validated. A prudent diet was characterized by the consumption of more vegetables, fruit, fish, poultry, and whole grains. A western diet was characterized by a higher consumption of red meat, processed meat, french fries, high-fat dairy products, refined grains, and sweets and desserts.

The relative risk of type 2 diabetes in the cohort based on quintile of the western dietary pattern score was then determined. The relative risk for type 2 diabetes was lowest in the quintile with the lowest western dietary pattern score and highest in quintile 5 with the highest western dietary pattern score. When segregated by quintile of self-reported physical activity (lowest physical activity is quintile 1), the relative risk of diabetes based on the western dietary pattern score was increased further in those who participated in little or no physical activity. It is also apparent from these data that physical activity alone does not completely offset the increased relative risk of type 2 diabetes associated with eating foods that are high in saturated fats and refined sugars.

Reference:

van Dam RM, Rimm EB, Willett WC, Stampfer MJ, Hu FB. Dietary patterns and risk for type 2 diabetes mellitus in U.S. men. Ann Intern Med. 2002;136(3):201-209.

Relative Risk for Type 2 Diabetes



van Dam RM, et al. Ann Intern Med. 2002;136:201-209.

www.hypertensiononline.org

Relative Risk for Type 2 Diabetes in US Men by BMI

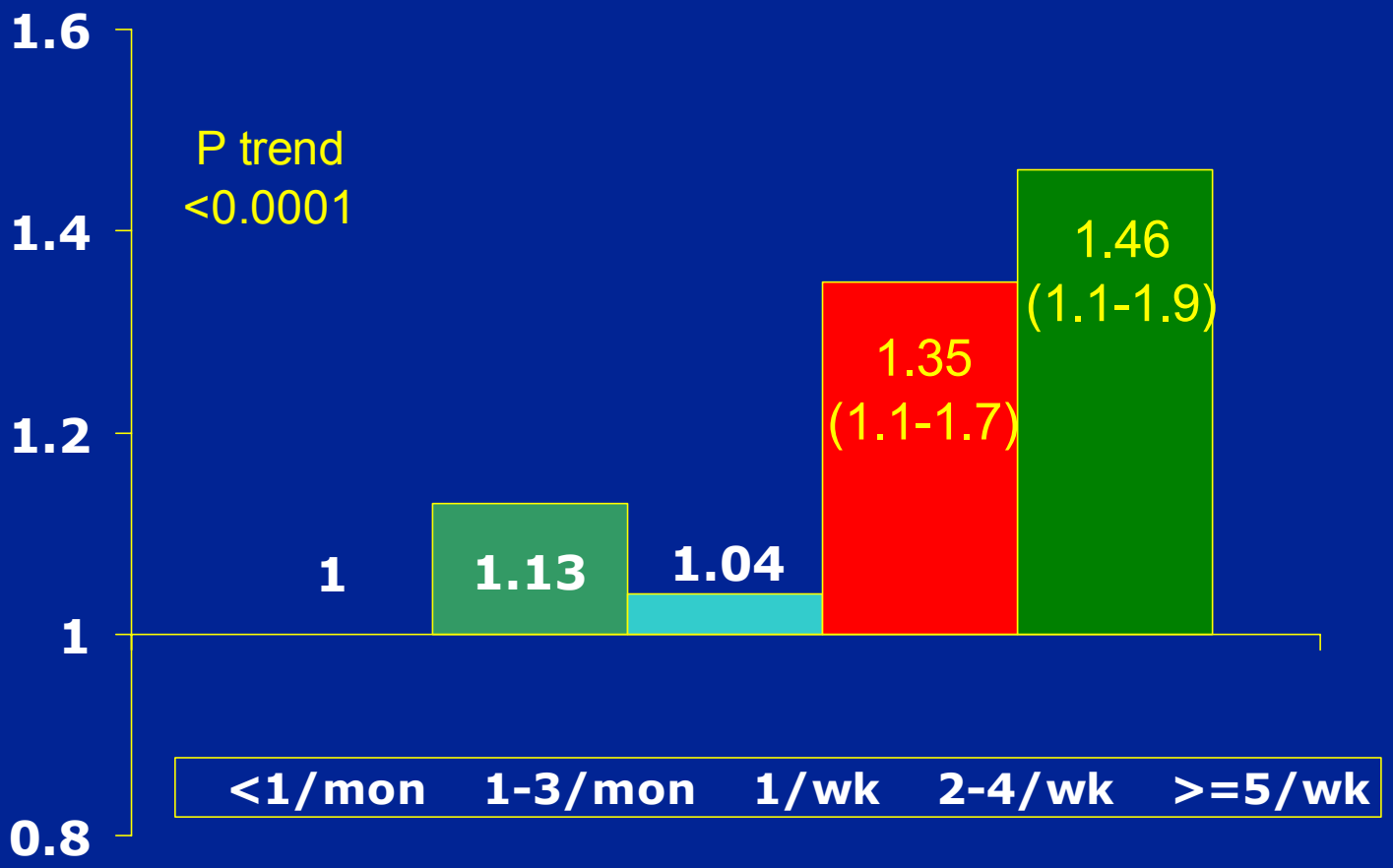
These data are from The Health Professionals Follow-up Study of 51,529 male health professionals. To assess dietary patterns, a 131-item food-frequency questionnaire was administered in 1986, 1990, and 1994. Using factor analysis based on data from these questionnaires, two major dietary patterns, "prudent" and "western", were validated. A prudent diet was characterized by the consumption of more vegetables, fruit, fish, poultry, and whole grains. A western diet was characterized by a higher consumption of red meat, processed meat, french fries, high-fat dairy, refined grains, and sweets and desserts.

The relative risk of type 2 diabetes in the cohort based on quintile of the western dietary pattern score was then determined. The relative risk for type 2 diabetes was lowest in the quintile with the lowest western dietary pattern score and highest in quintile 5, with the highest western dietary pattern score. Across all quintiles of western but not prudent dietary pattern score, the relative risk of type 2 diabetes in these US male health professionals increased as the body mass index increased.

Reference:

van Dam RM, Rimm EB, Willett WC, Stampfer MJ, Hu FB. Dietary patterns and risk for type 2 diabetes mellitus in U.S. men. Ann Intern Med. 2002 Feb 5;136(3):201-209.

Processed meats and relative risk of type 2 diabetes



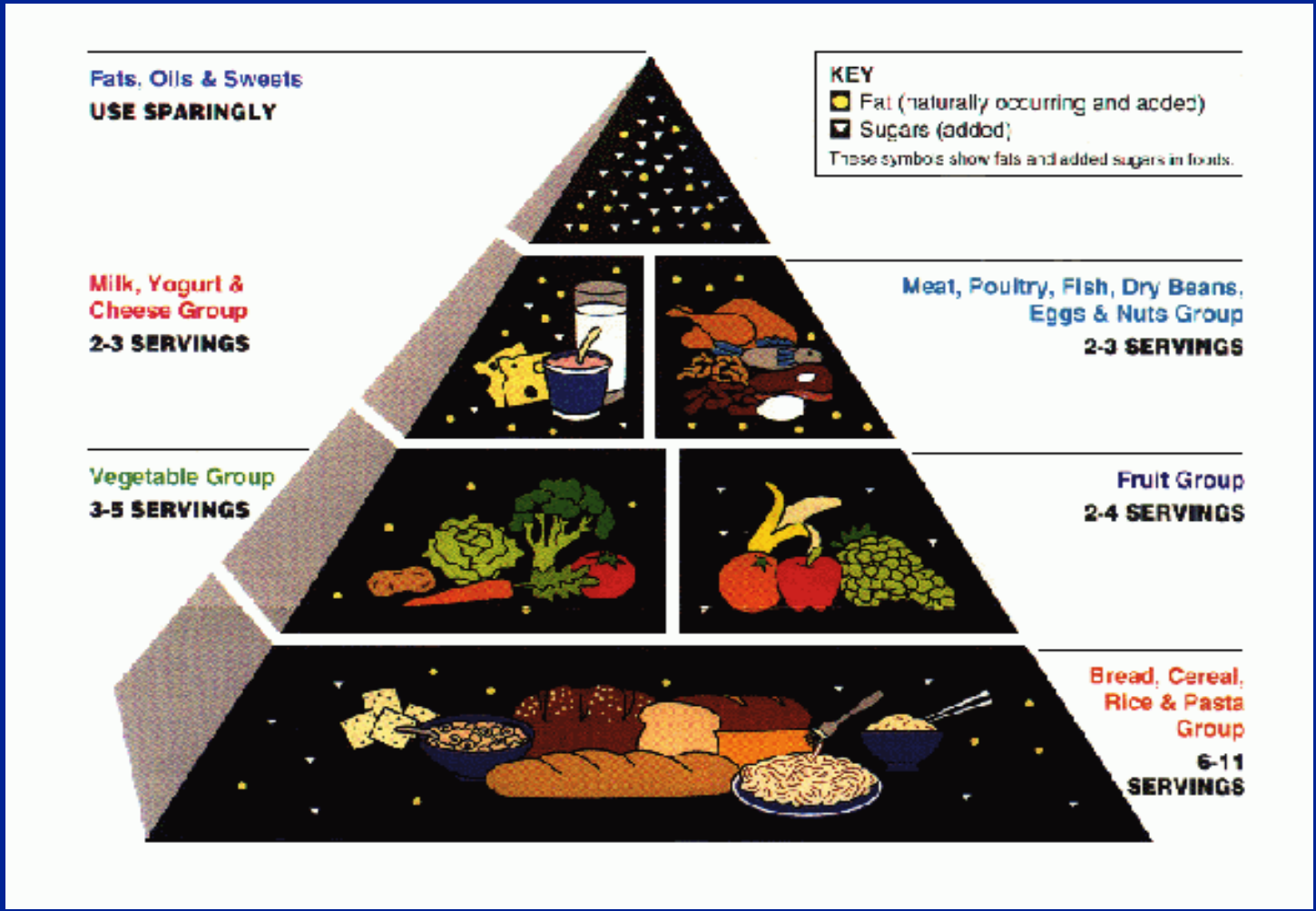
Van Dam 2001

Diabetes Care

Protein Content of Selected Foods

	Serving size	Amount of protein (g)
Ground beef	4 oz	33
Chicken	4 oz	31
Tuna	4 oz	33
Cottage cheese	1 cup	15
Tofu	1/2 cup	10
Peanut butter	2 Tbsp	10
Lentiles	½ cup	9
Skim milk	1 cup	8
Peas	½ cup	8
Cheddar cheese	1 oz	7
Egg	1	6
Almonds	1 oz	6
Whole wheat bread	2 slices	6
Rice	1 cup	4
Corn	1 ear	3

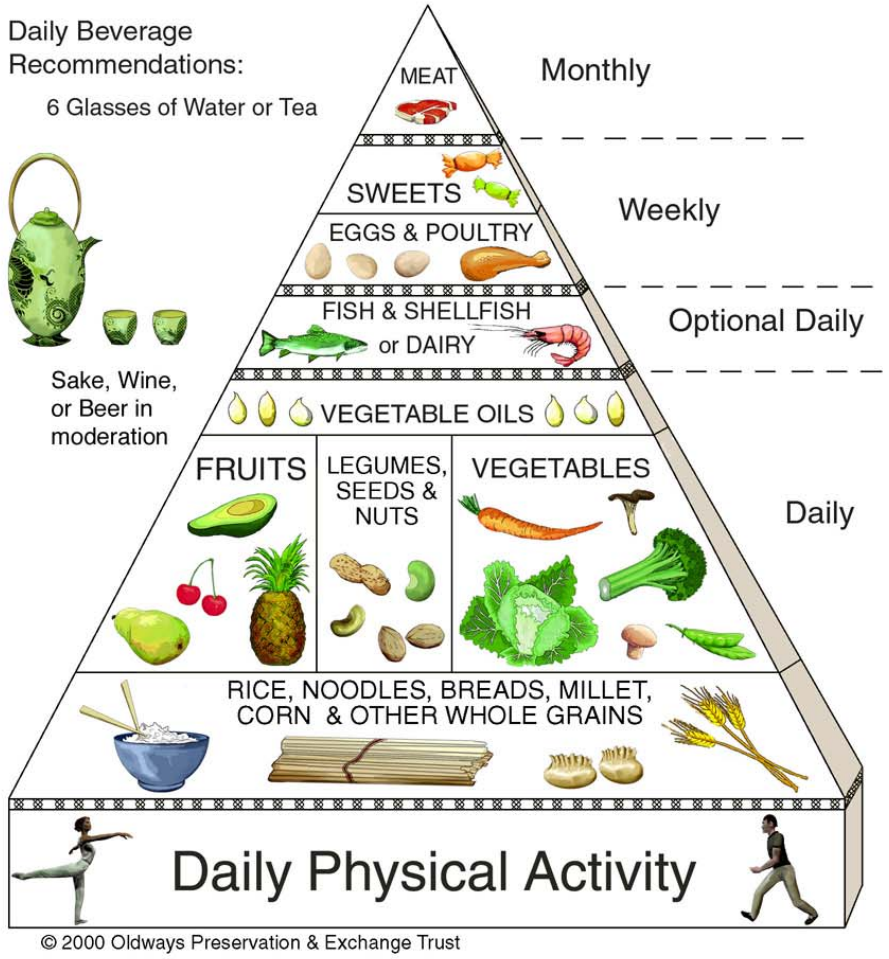
Is the Food Guide Pyramid Obsolete?



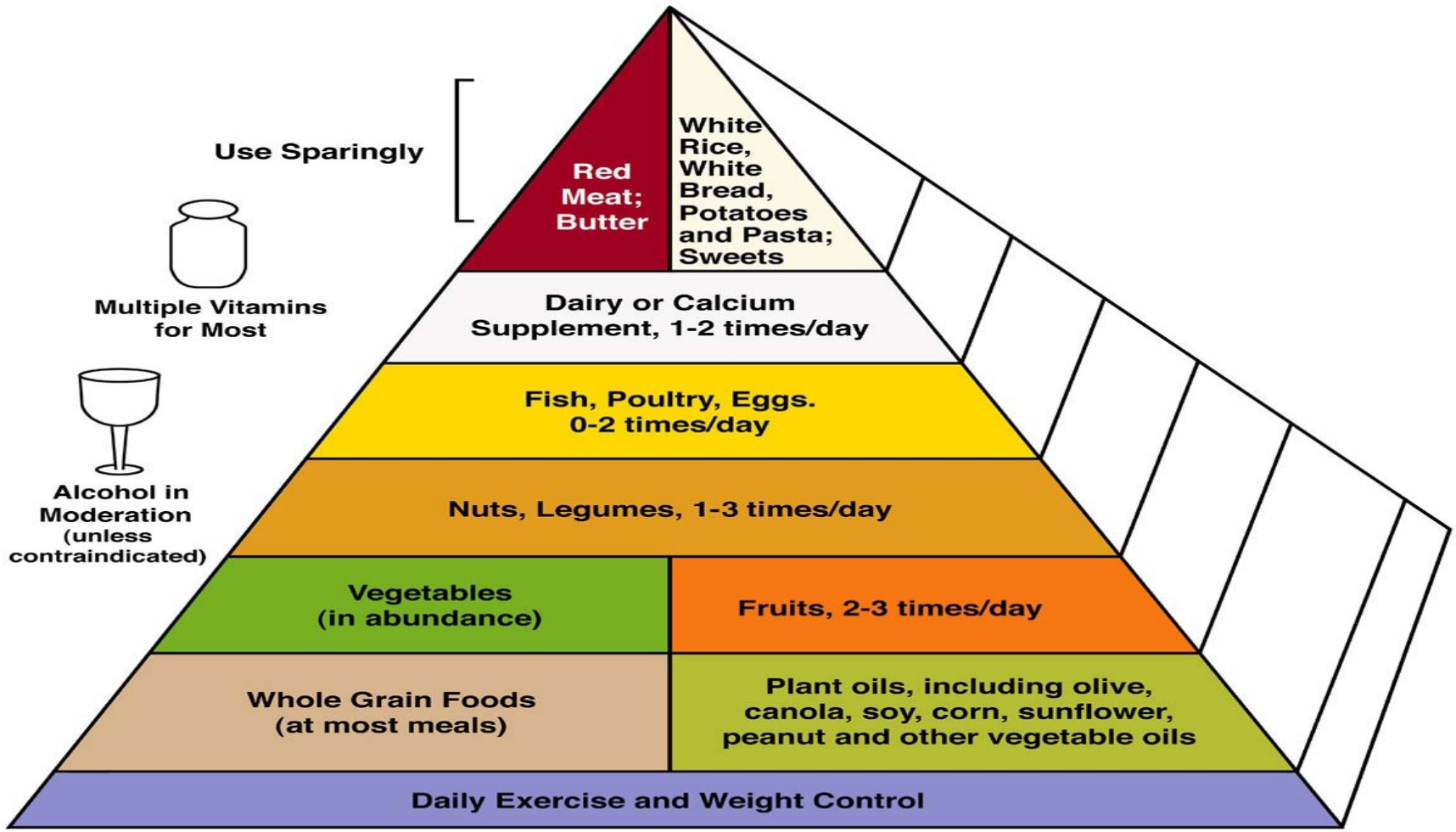
The Traditional Healthy Mediterranean Diet Pyramid

http://www.oldwayspt.org/pyramids/med/p_med.html

The Traditional Healthy Asian Diet Pyramid



The Healthy Eating Pyramid



(from Willett et al, 2001, "Eat Drink and Be Healthy: The Harvard Medical School Guide to Healthy Eating")

Dietary Guidelines for Americans 2000

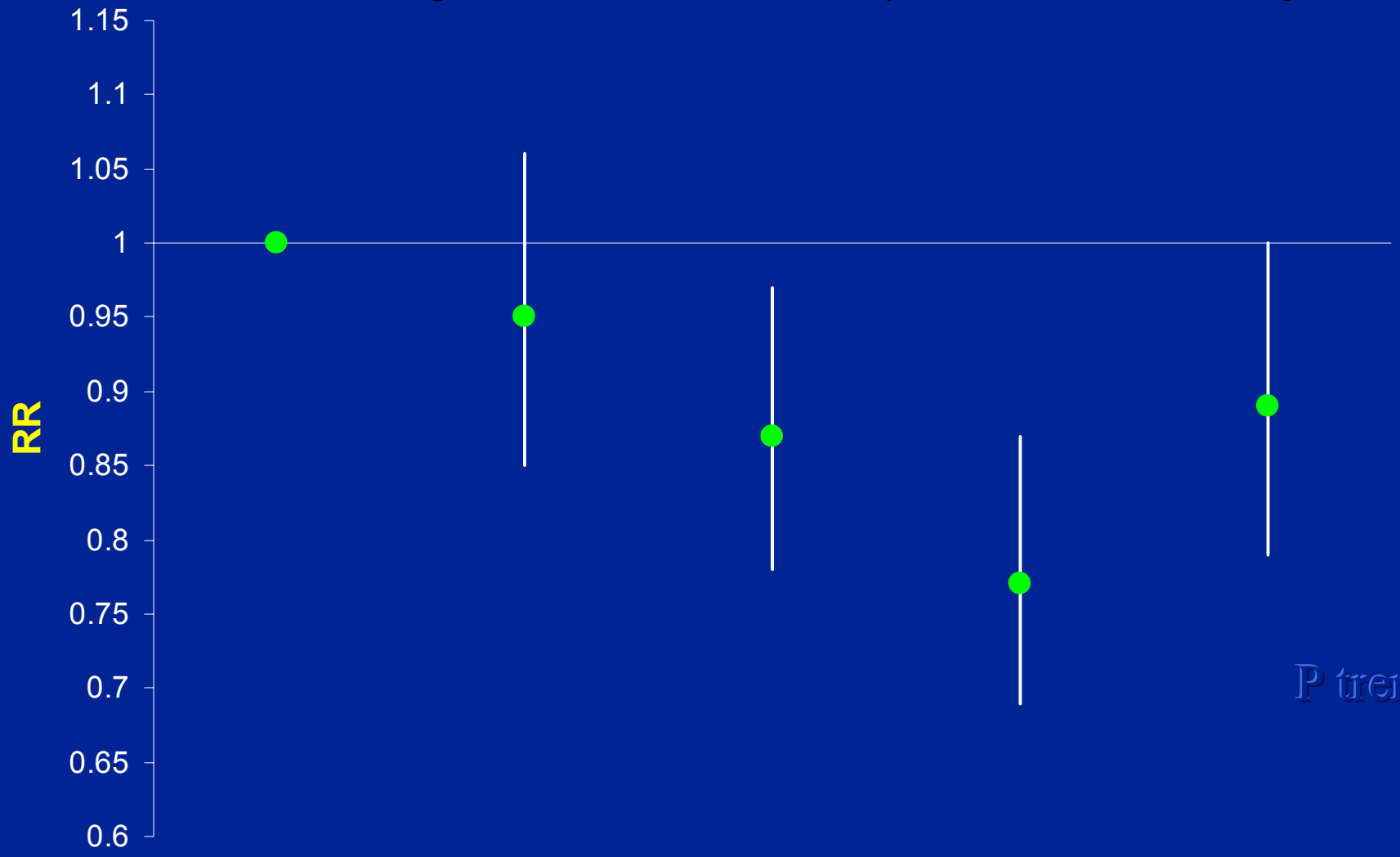
- Aim for a healthy weight
- Be physically active each day
- Let the Pyramid guide your food choices
- Choose a variety of grains daily, especially whole grains
- Choose a variety of fruits and vegetables daily
- Keep food safe to eat
- Choose a diet low in saturated fat and cholesterol and moderate in total fat
- Choose beverages and foods that limit your intake of sugars
- Choose and prepare foods with less salt
- If you drink alcoholic beverages, do so in moderation

Healthy Eating Index Scoring Criteria*

Component	Criteria for maximum score of 10	Criteria for minimum score of 0
1. Grains (svgs/d)	6-11	0
2. Vegetables (svgs/d)	3-5	0
3. Fruits (svgs/d)	2-4	0
4. Milk (svgs/d)	2-3	0
5. Meat (svgs/d)	2-3	0
6. Total Fat (% kcal)	≤30%	≥45%
7. Saturated Fat (% kcal)	<10%	≥15%
8. Cholesterol (mg)	<300	≥450
9. Sodium (mg)	<2,400	≥4,800
10. Variety	16 different food items over 3 days	≤6 different food items over 3-day
Total Score	100 (best)	0 (worst)

*Kennedy, et al, JADA, 1995

Relative Risk of Major Chronic Disease in Men, According to HEI Quintile (multivariate-adjusted)



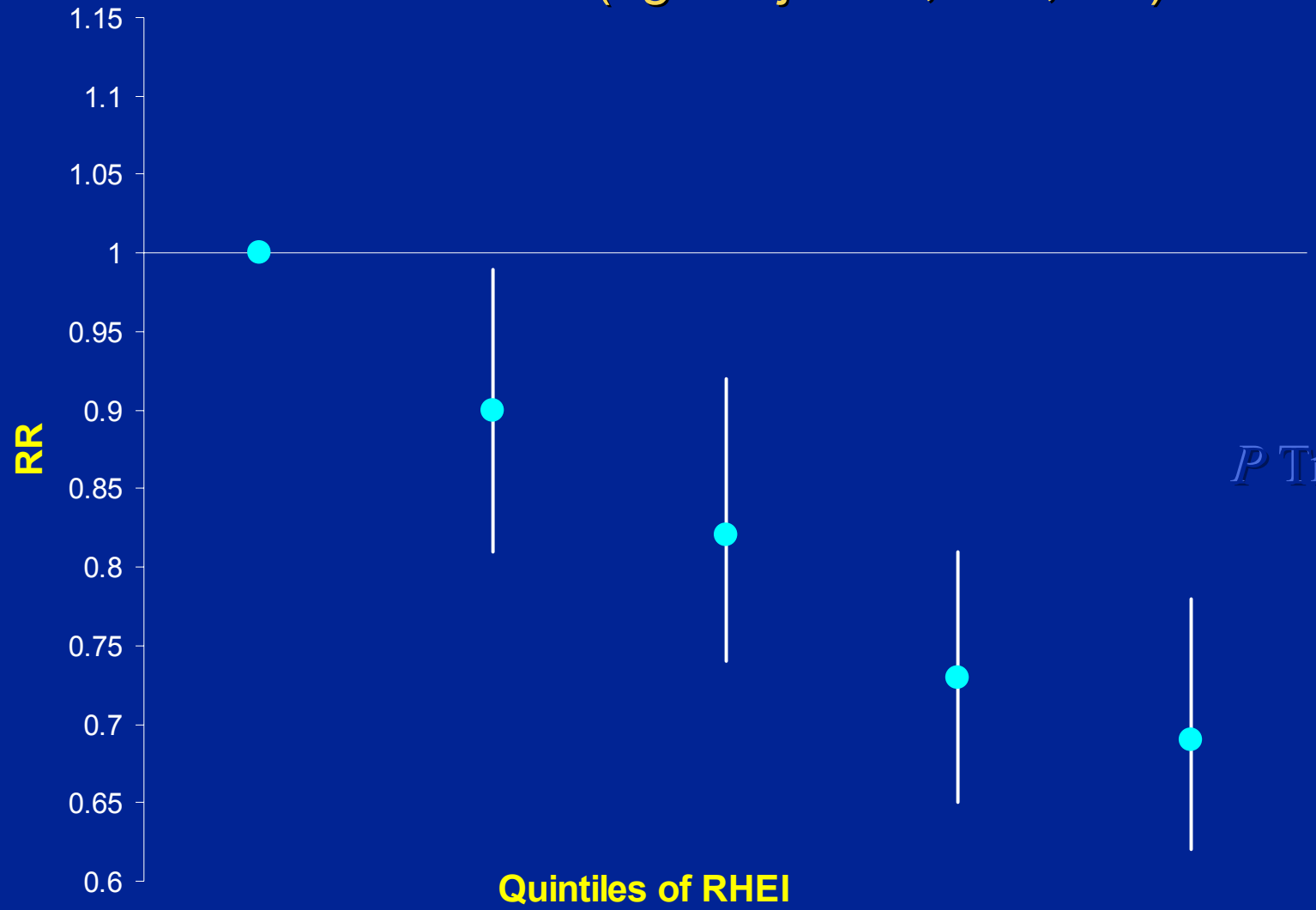
McCullough 2000 AJCN

Revised Healthy Eating Index

Component	Criteria for maximum score of 10	Criteria for minimum score of 0	RHEI Scores 1986 (Mean ± S.D.)
1. Vegetables (svgs/d)	5	0	5.9 ± 2.6
2. Fruits (svgs/d)	4	0	5.5 ± 2.9
3. Nuts (svgs/d)	1	0	4.2 ± 3.4
4. White:red meat ratio	4	0	3.8 ± 3.2
5. Cereal Fiber (gm/d)	15	0	4.5 ± 2.2
6. Trans Fat (% kcal)	≤0.5%	≥4%	7.8 ± 1.4
7. P:S ratio	>1	<0.1	5.7 ± 1.8
8. Multivitamin Use	>5 years = 7.5	other = 2.5	3.7 ± 2.2
9. Alcohol, svgs/d*	1.5-2.5 /day	0, or > 3.5 /day	3.8 ± 3.2
Total Score (range)	87.5	2.5	45 ± 10.9 (10 - 86)

*beer, wine, spirits

Relative Risk of Major Chronic Disease in Men, According to Revised HEI (age-adjusted, n=3,119)



P Trend <.001

McCullough et al. 2002 AJCN

Key Research Issues in Diet and CHD/Diabetes

- Is the total fat recommendation scientifically sound? Should the 30% limit be abolished?
- Is refined carbohydrate worse than saturated fat?
- Should we eat more protein?
- Is the USDA food guide pyramid obsolete?
- Is there a single optimal diet for everyone?

Conclusions

- Type 2 diabetes and CHD is largely preventable by diet and lifestyle.
- Quality of fat and carbs is more important than quantity.
- Reducing consumption of refined carbohydrate should be a major public health priority.
- A diet with moderately high protein is probably beneficial.
- Current dietary guidelines put too much emphasis on carbs.

- More flexible dietary recommendations:

Fat: 25-45% E, mostly mono, poly, and n-3.
Protein: 20-25% E: mostly from poultry, fish, nuts, legumes, low-fat dairy
Carbs: 30-55% E: mostly whole grains, legumes, fruits, vegetables.

Acknowledgment

Eunyong Cho
Marji McCullough
Rui Jiang
Simin Liu
Eric Rimm
Meir Stampfer
Jorge Salmeron
JoAnn Manson
Miheala Tanasuscu
Rob Van Dam
Walter Willett