



Macronutrients and Health: A Focus on Diabetes

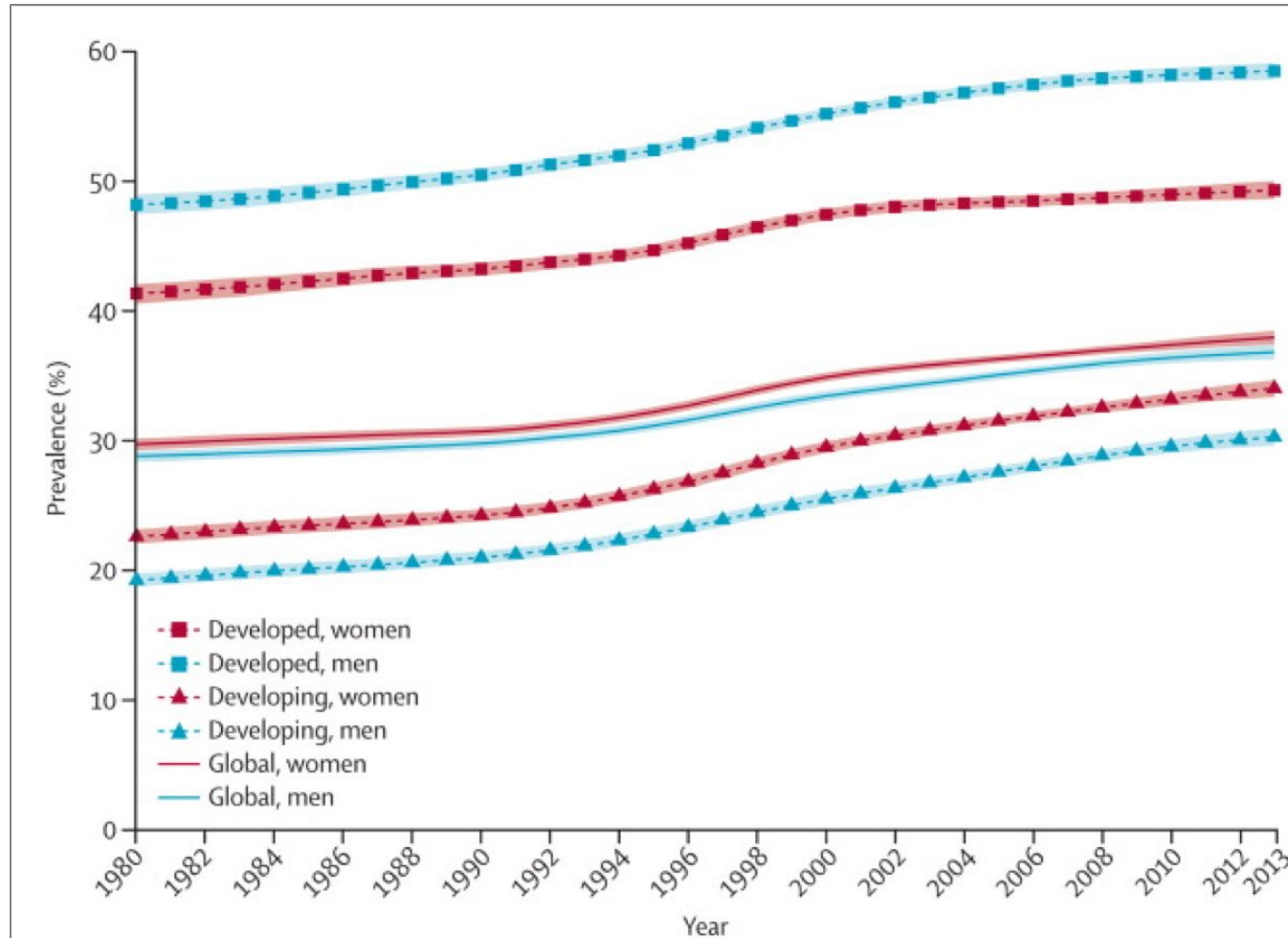
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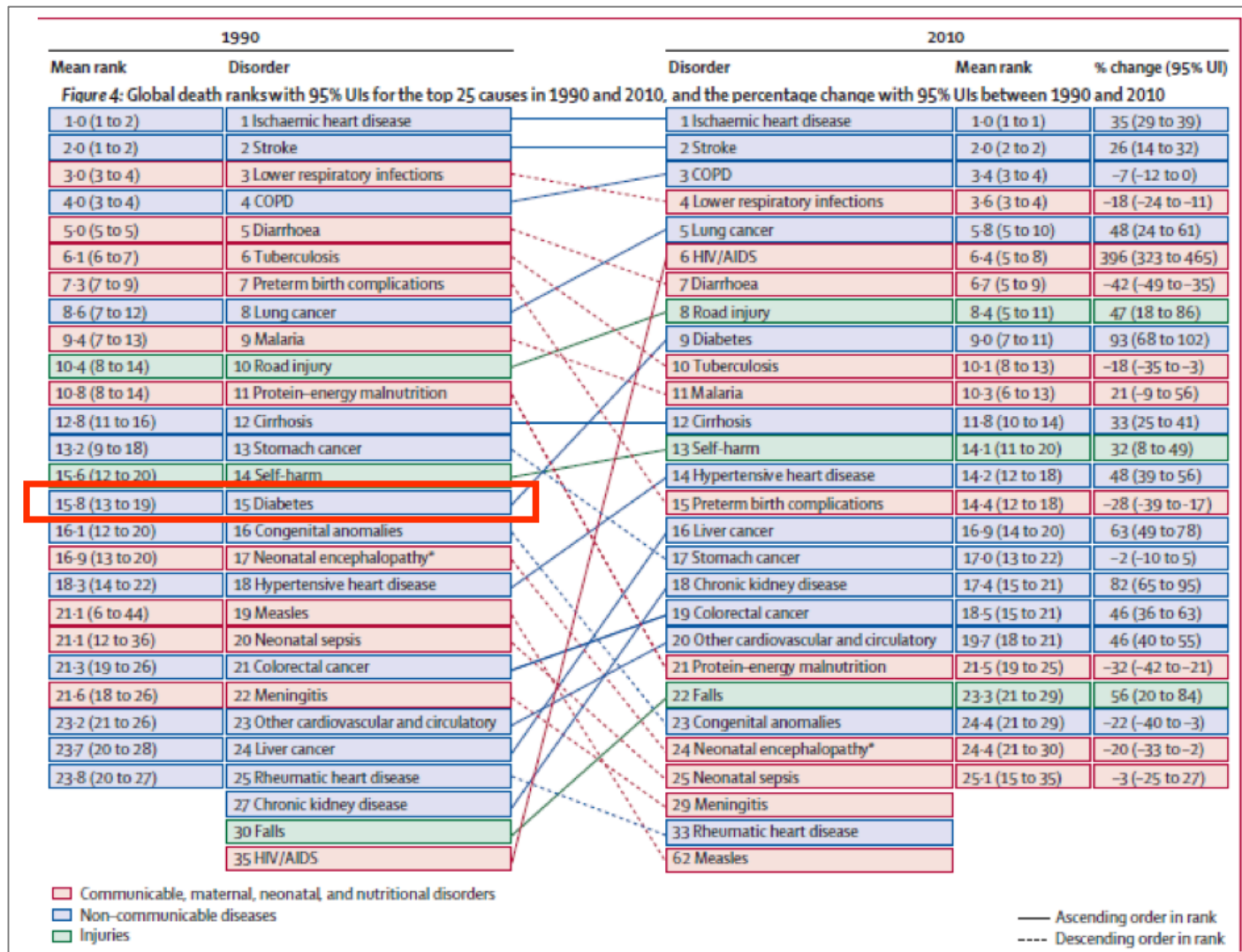
March 8, 2019

Changes in Prevalence of Overweight/Obesity from 1980 to 2012



Ng, Marie et al., "Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013." *The Lancet*, Volume 384, Issue 9945, 766–781

Global Death Ranks and Percent Change for Top 25 Causes in 1990 and 2010



Lozano, Rafael et al. "Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010" *The Lancet* 2010, 380; 9859, 2095–2128

Chronic Illnesses Among Adult Hannahville Indians

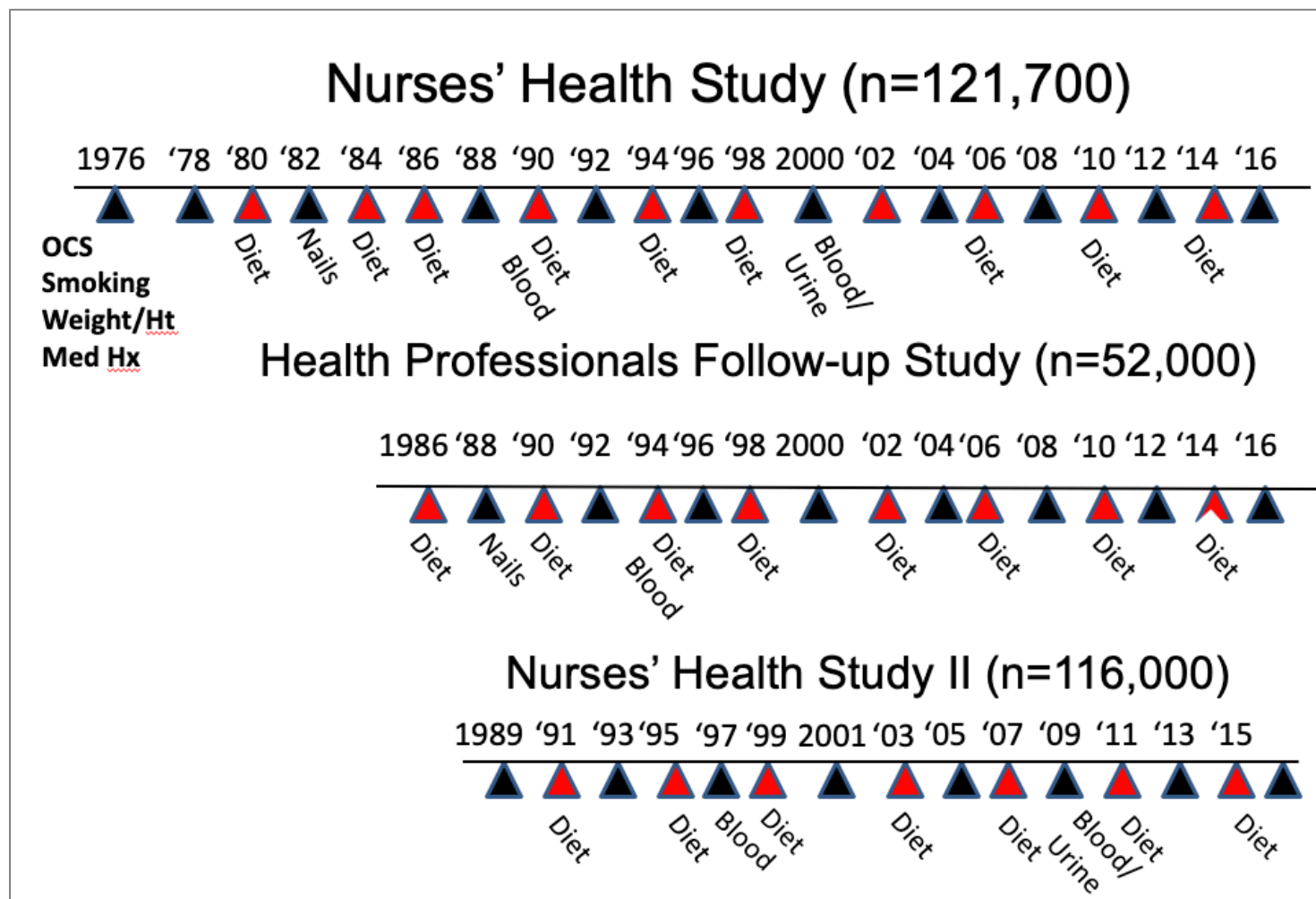
TABLE V
CHRONIC ILLNESSES
AMONG ADULT HANNAHVILLE INDIANS

	Hannahville Indians	General American Adult Population	
	N = 39*		
	Number with Condition	Percent with Condition	Percent with Condition
History of TB	7	17.9%	—
Obesity	14*	42.4%	8.5% 19
History of GI Ulcer	5	12.8%	10.0% 20
Hypertension	4	10.3%	15.9% 21
Diabetes	8	20.5%	1.5% 22

*Data on weight is available on 84.6% (33 of 39) of adult Indians.

Willett WC, Foulke RA, Robson JRK., Block WD, Perlman LV. "Health and nutrition in Michigan Indians." Mich Med 1970; 69: 305–11.

Nurse's Health Study



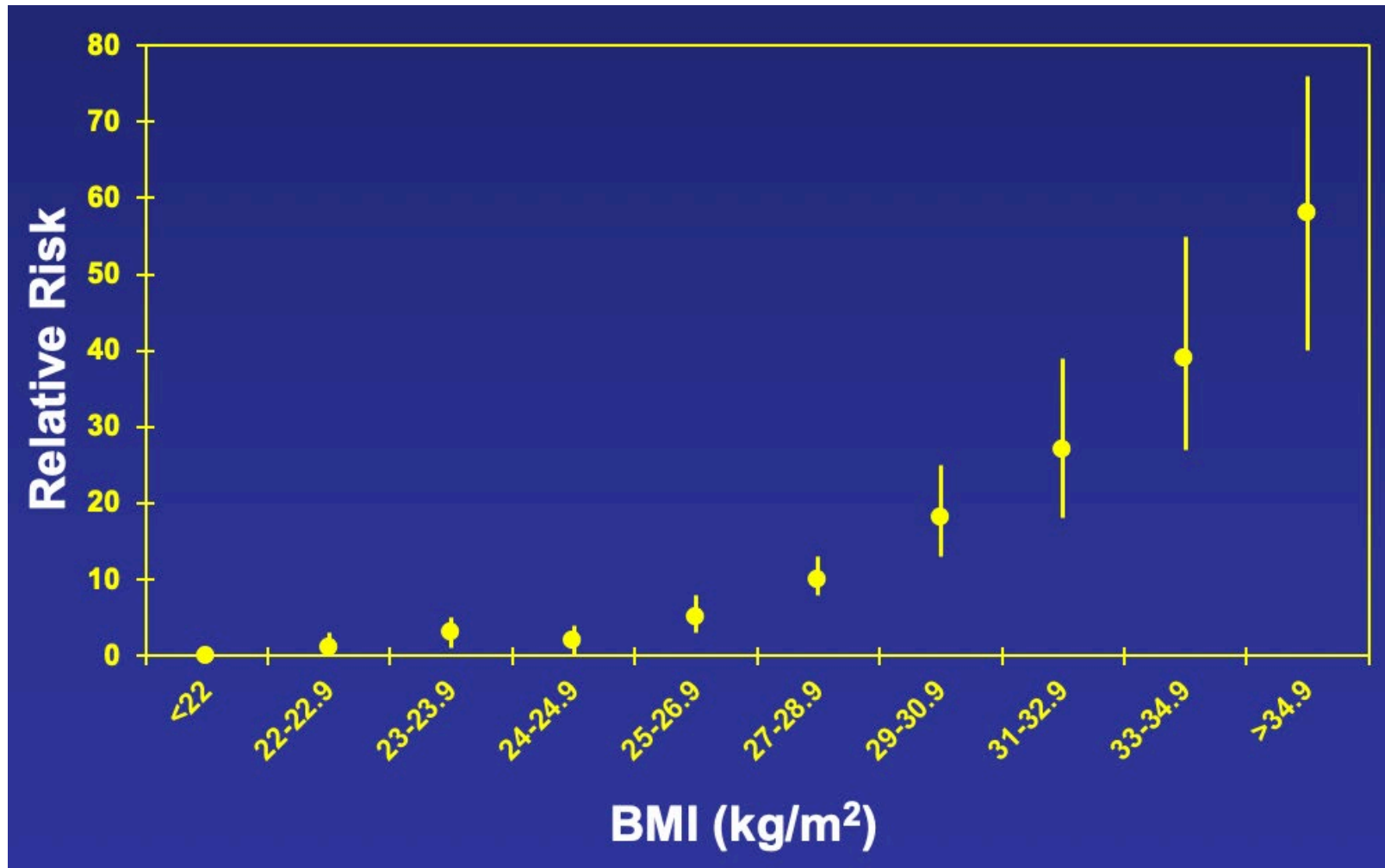
Investigators: Frank Speizer, Bernie Rosner, Meir Stampfer, Graham Colditz, David Hunter, JoAnn Manson, Sue Hankinson, Eric Rimm, Edward Giovannucci, Alberto Ascherio, Gary Curhan, Charles Fuchs, Fran Grodstein, Michelle Holmes, Donna Spiegelman, Frank Hu, Heather Eliassen, Lorelei Mucci

First Food Frequency Questionnaire

For each food listed, fill in the circle indicating how often on average you have used the amount specified during the past year.

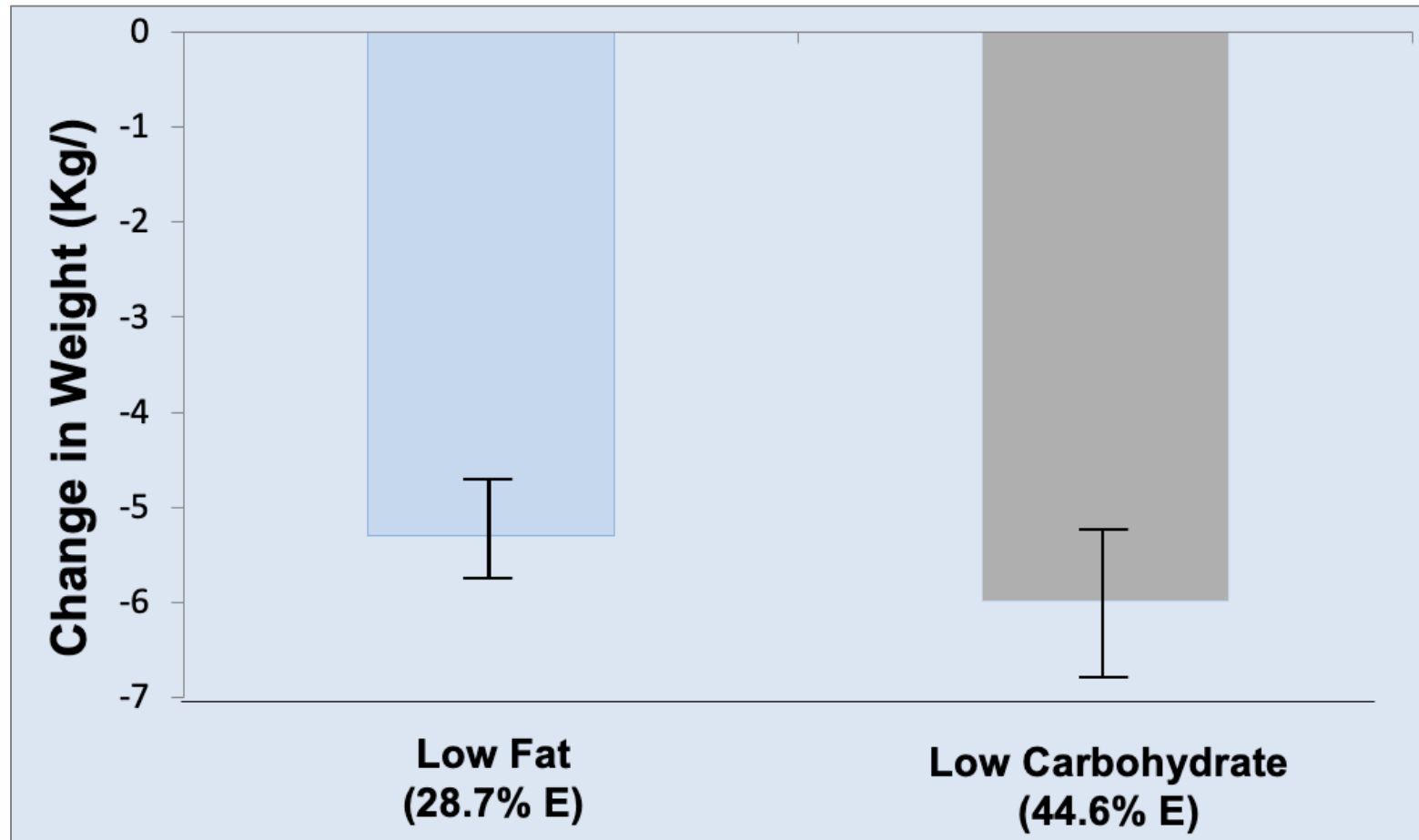
	AVERAGE USE LAST YEAR									1 2 P
	Never, or less than once per month	1-3 per mo.	1 per week	2-4 per week	5-6 per week	1 per day	2-3 per day	4-5 per day	6+ per day	
DAIRY FOODS										
Skim or low fat milk (8 oz. glass)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Whole milk (8 oz. glass)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cream, e.g. coffee, whipped (Tbs)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sour cream (Tbs)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Non-dairy coffee whitener (tsp.)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sherbet or ice milk (1/2 cup)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ice cream (1/2 cup)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Yogurt (1 cup)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cottage or ricotta cheese (1/2 cup)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cream cheese (1 oz.)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other cheese, e.g. American, cheddar, etc., plain or as part of a dish (1 slice or 1 oz. serving)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Margarine (pat), added to food or bread; exclude use in cooking	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Butter (pat), added to food or bread; exclude use in cooking	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Body Mass Index and Risk of Diabetes



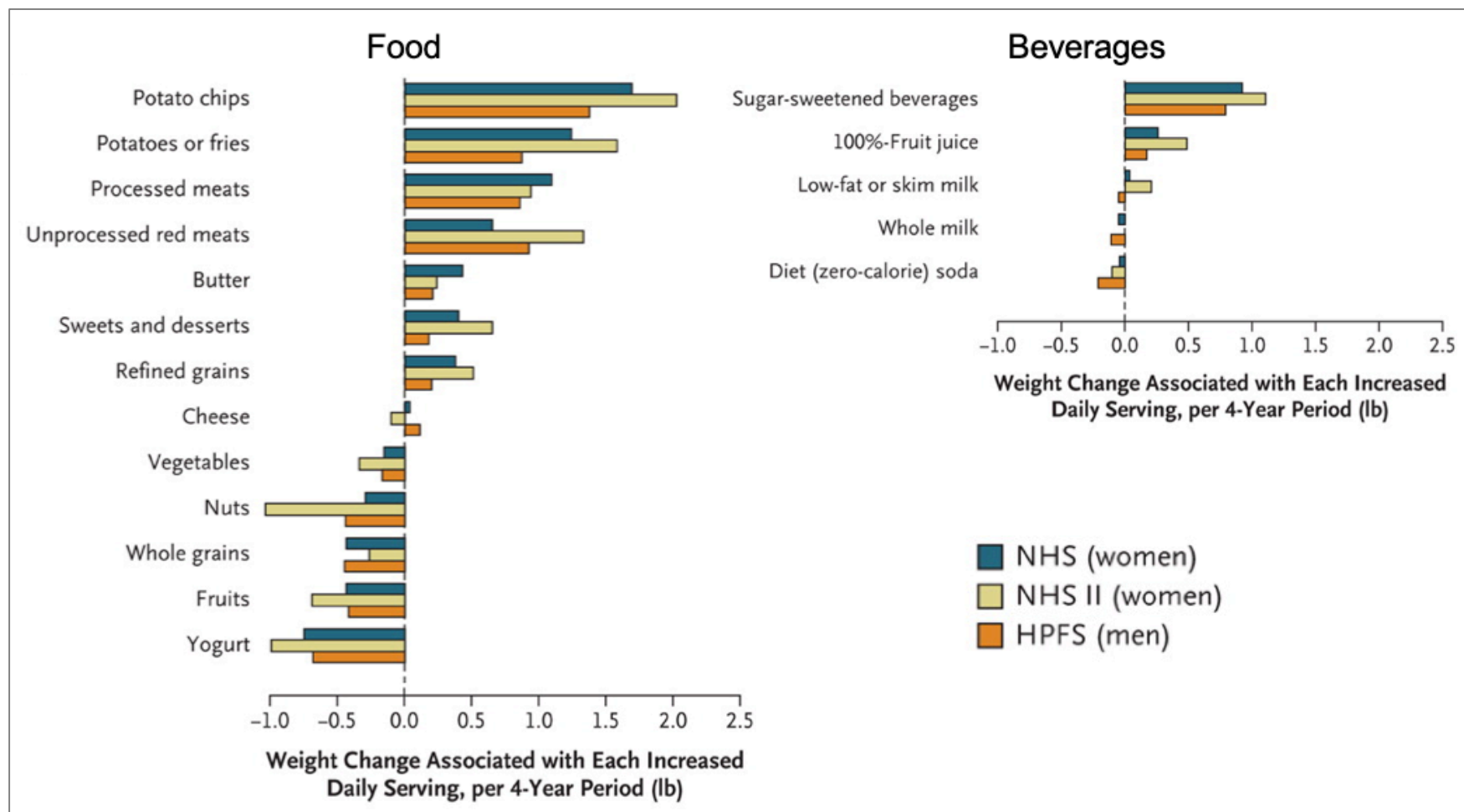
Colditz, G.A. et al. "Weight as a risk factor for clinical diabetes in women." *American Journal of Epidemiology* October 1990, 132; 4, 612–628.

12 Month Change in Weight



Gardner CD, Trepanowski JF, Del Gobbo LC, et al. "Effect of Low-Fat vs Low-Carbohydrate Diet on 12-Month Weight Loss in Overweight Adults and the Association With Genotype Pattern or Insulin Secretion: The DIETFITS Randomized Clinical Trial." *JAMA* 2018; 319(7): 667–679. doi:10.1001/jama.2018.0245

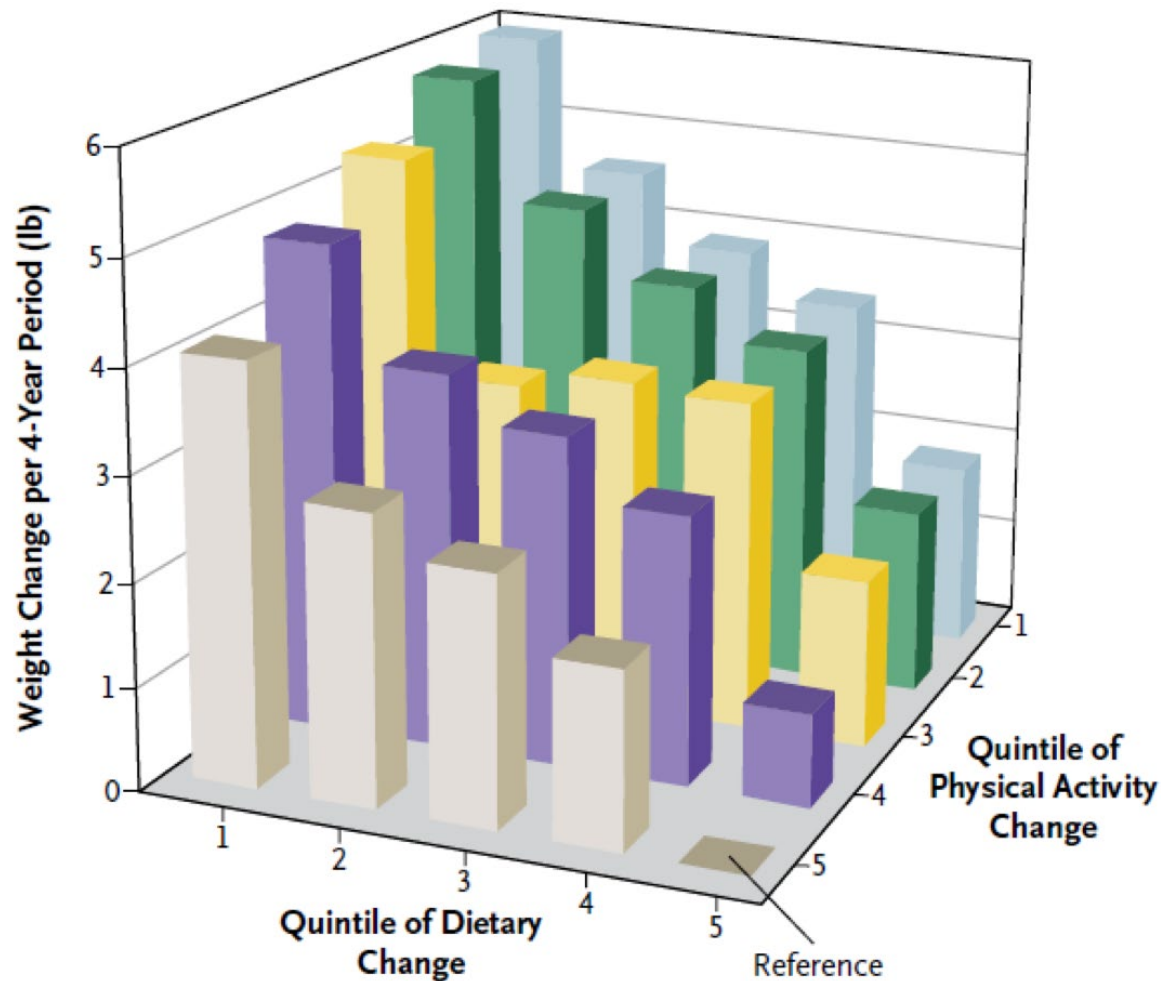
Changes in Food and Beverage Consumption and Weight Changes Every 4 Years According to Study Cohort



(Mozaffarian D et al., “Changes in Diet and Lifestyle and Long-Term Weight Gain in Women and Men” *The New England Journal of Medicine* 2011)

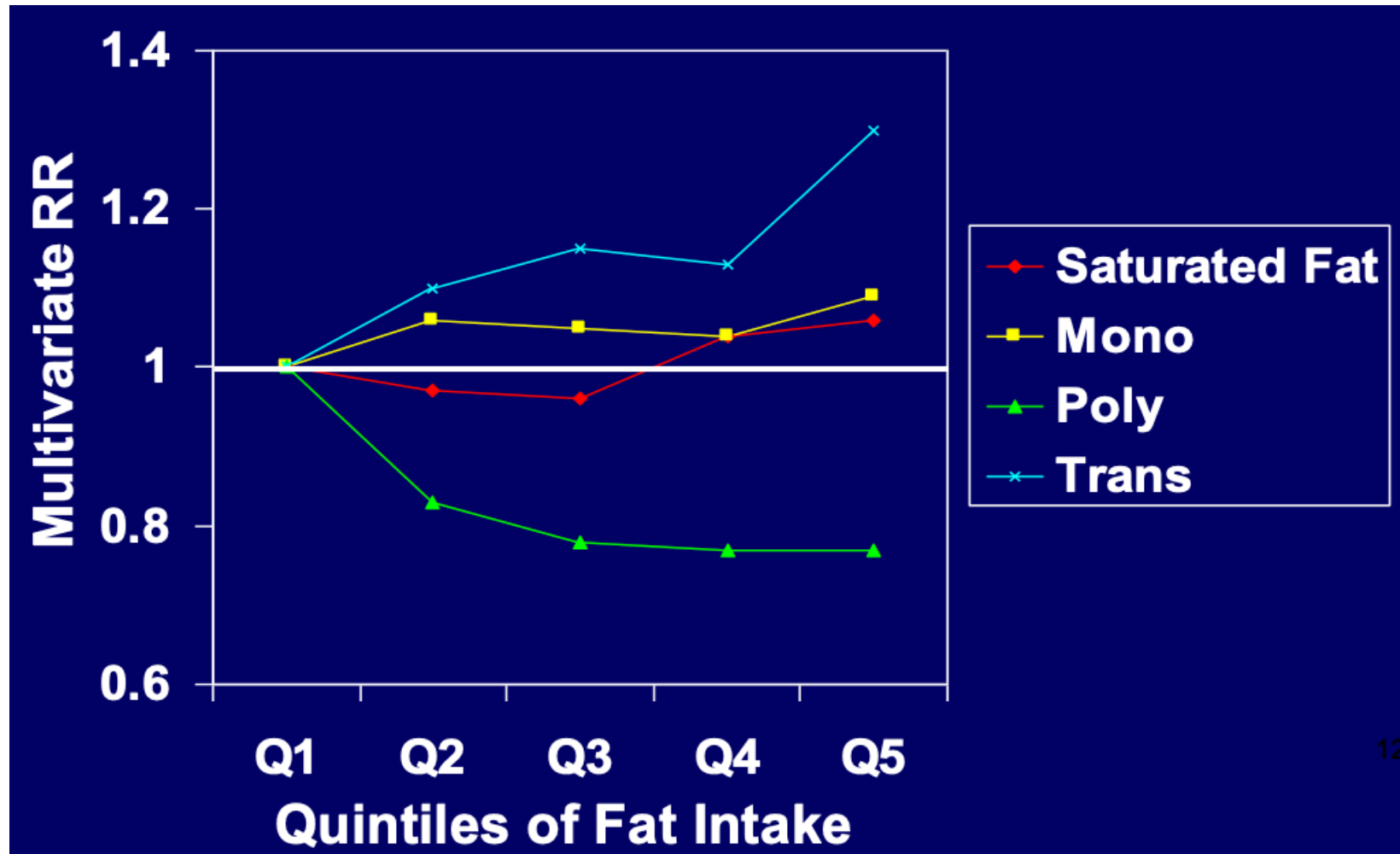
Changes in Diet and Physical Activity and Weight Changes Within each Four-year Period in Three Cohorts

B

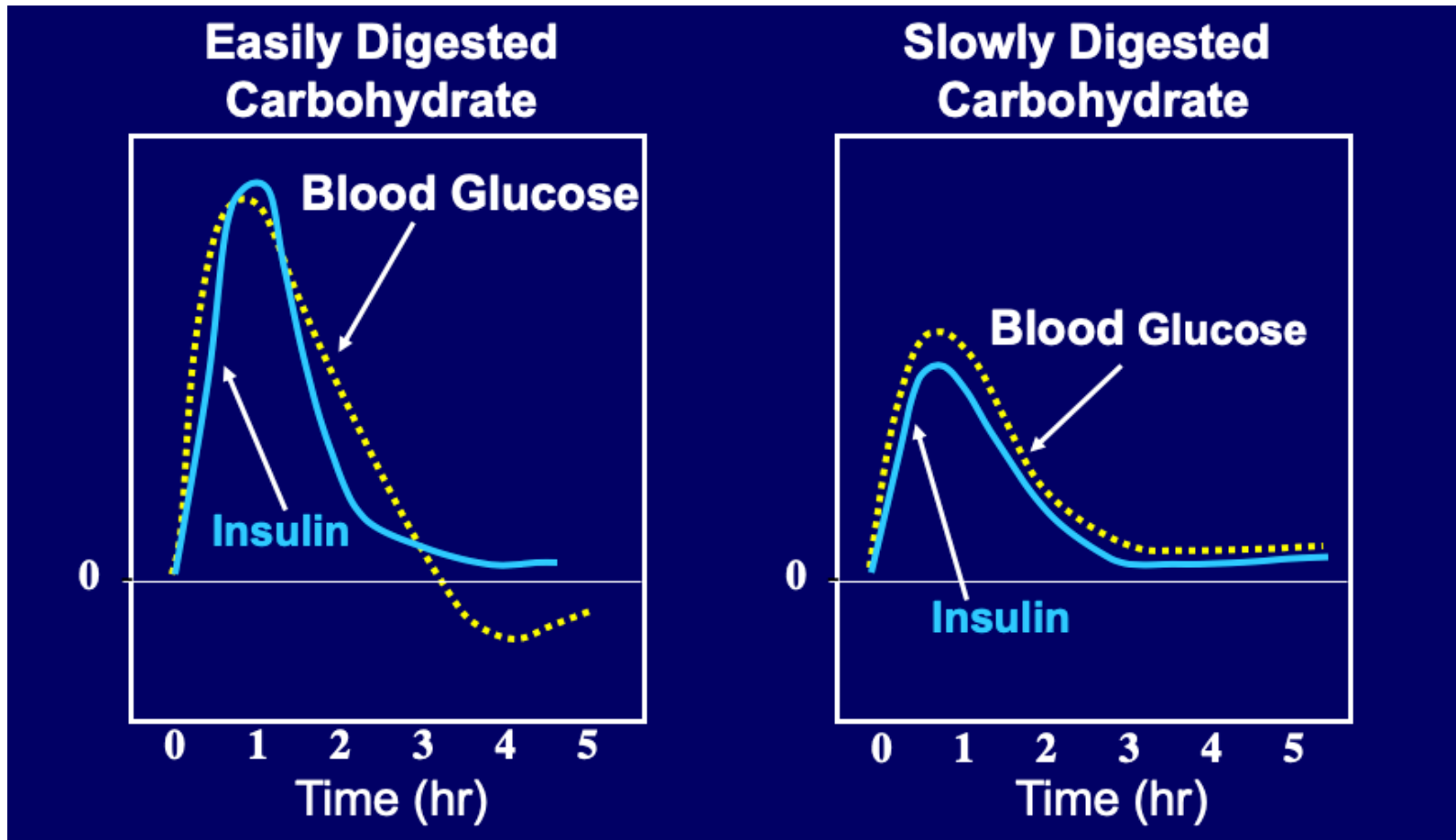


(Mozaffarian D et al., NEJM 2011)

Multivariate Relative Risks of Type 2 Diabetes According to Quintiles of Specific Types of Dietary Fat (Mutually Adjusted)

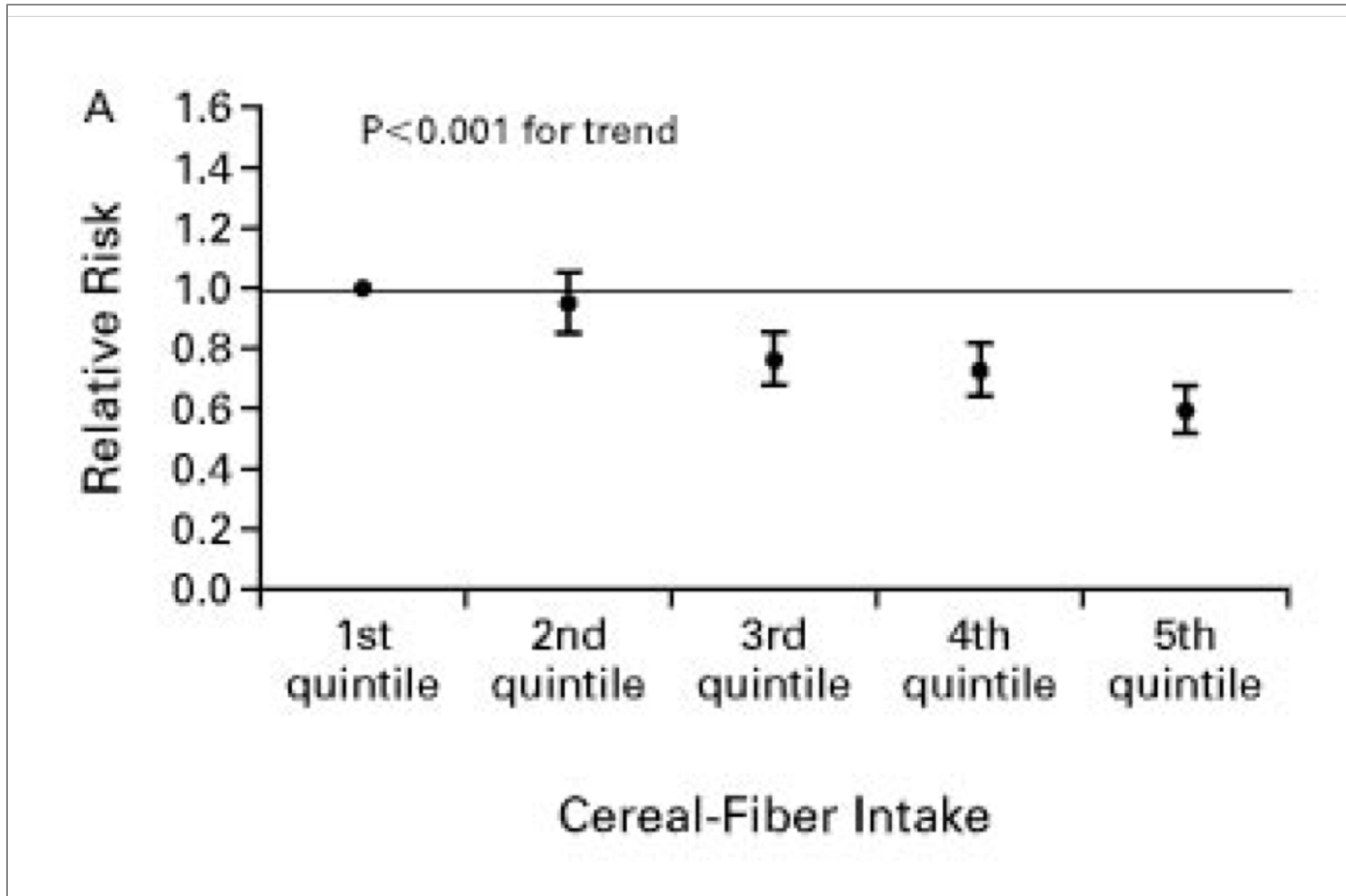


Types of Carbohydrates and Insulin Response



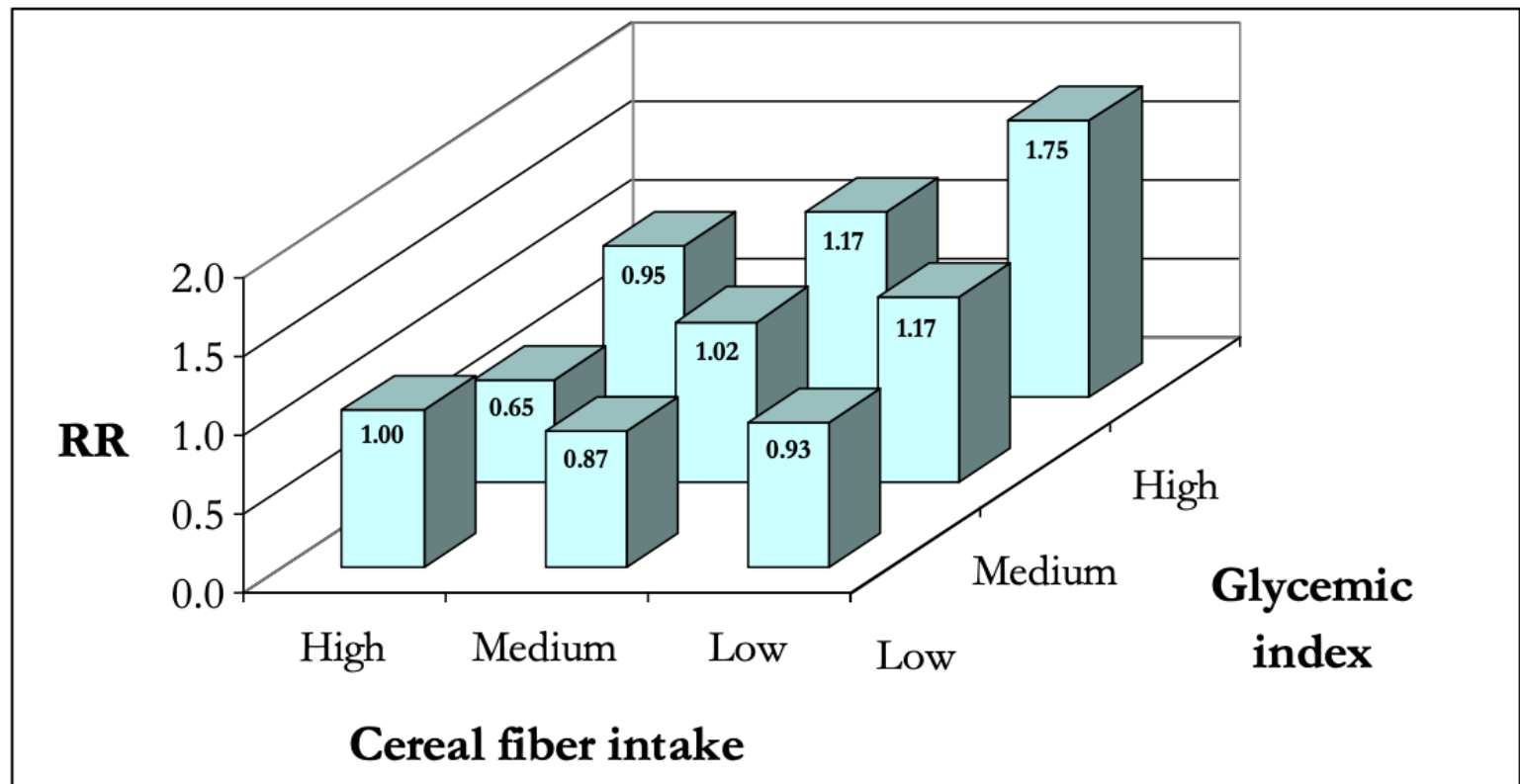
Glycemic Load =
Glycemic Index x Carbohydrate (CHO)

Relative Risk and Cereal Fiber Intake



Hu, FB et al. "Diet, lifestyle, and the risk of type 2 diabetes mellitus in women." *The New England Journal of Medicine* 2001; 345: 790–7

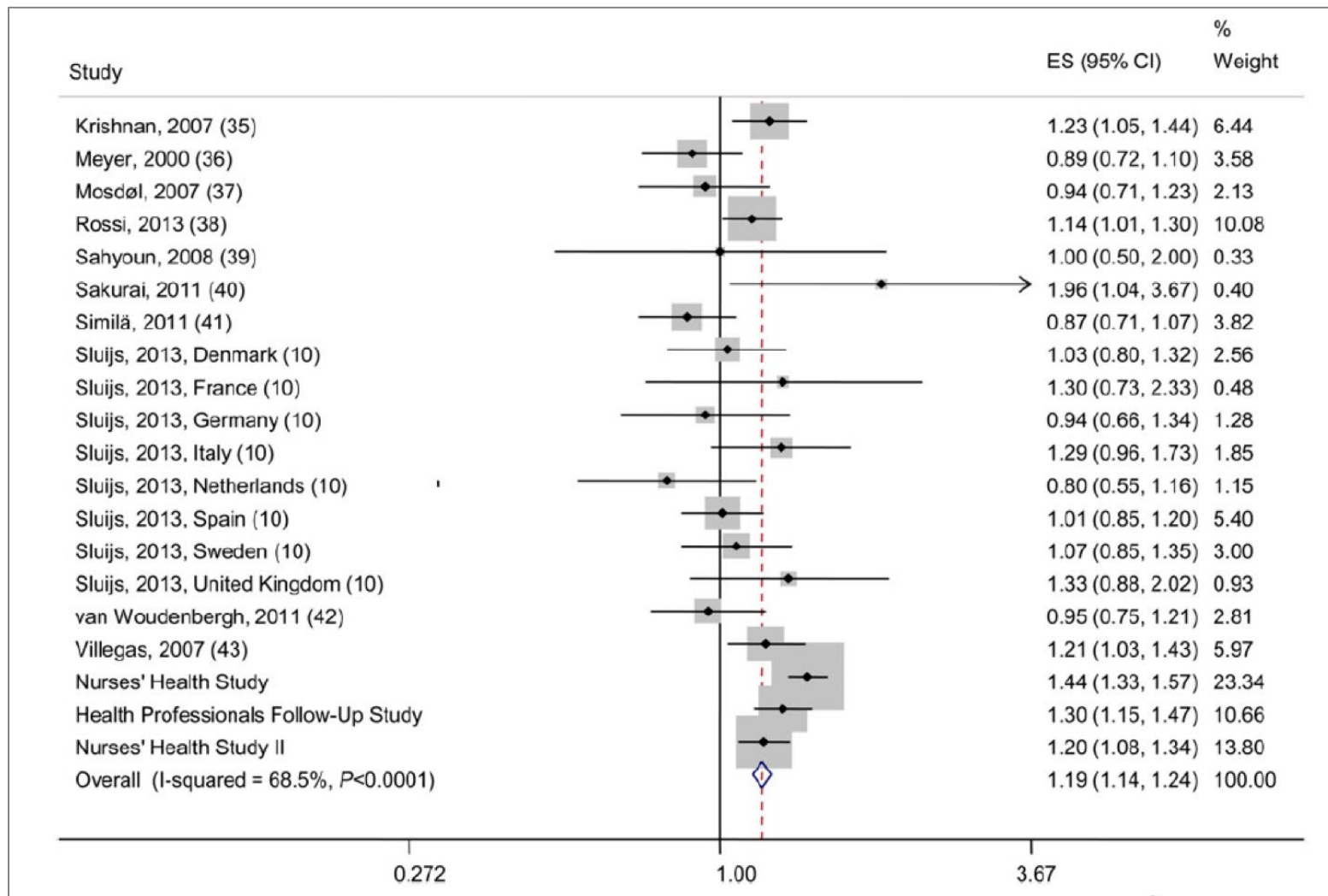
Results: Joint Effects of Glycemic Index and Cereal Fiber in the Nurses' Health Study II



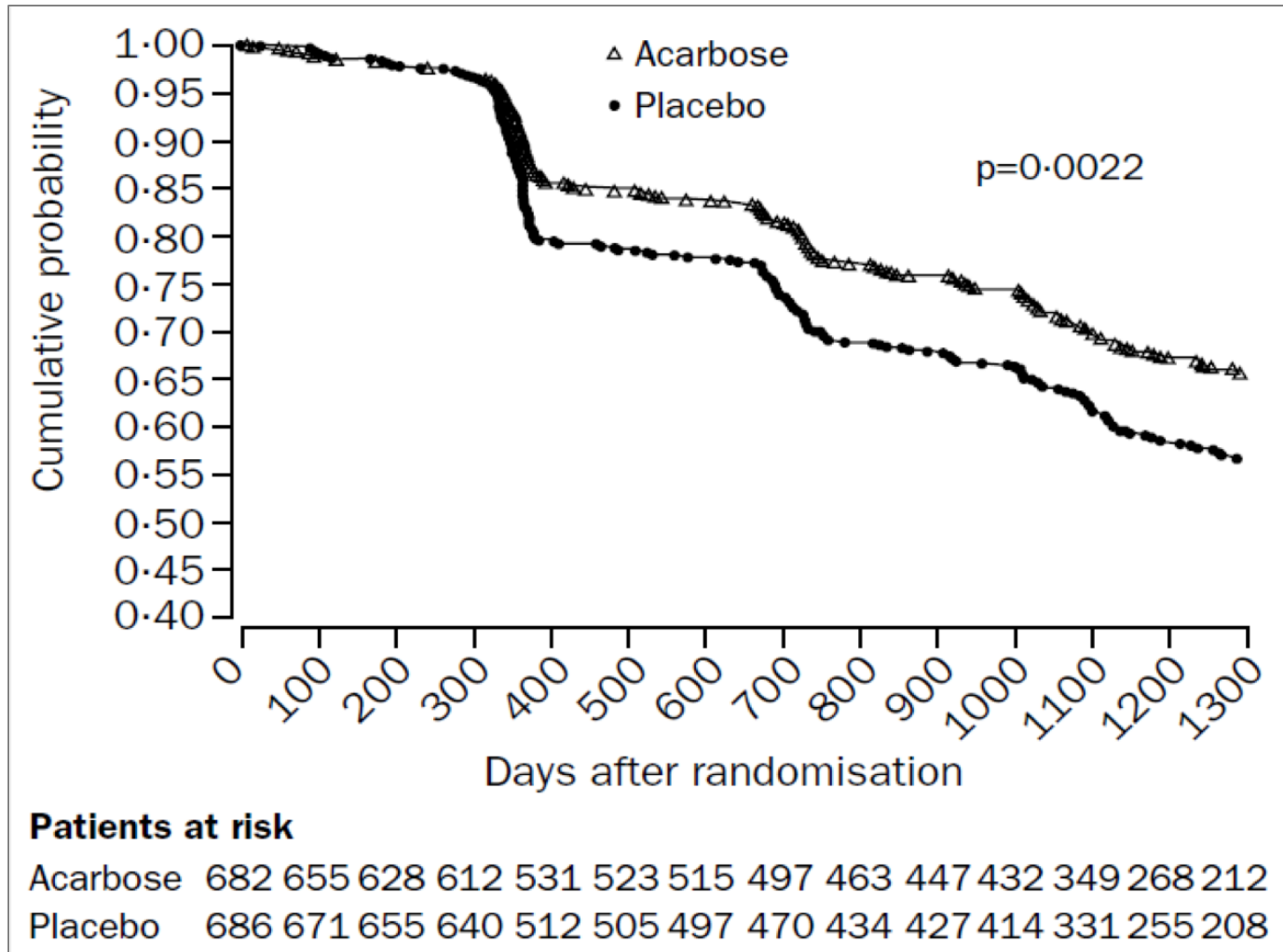
(RRs multivariate and diet adjusted)

Schulze MB, "Sugar-sweetened beverages, weight gain, and incidence of type 2 diabetes in young and middle-aged women." *JAMA*. 2004; 292(8): 927–934. doi:10.1001/jama.292.8.927

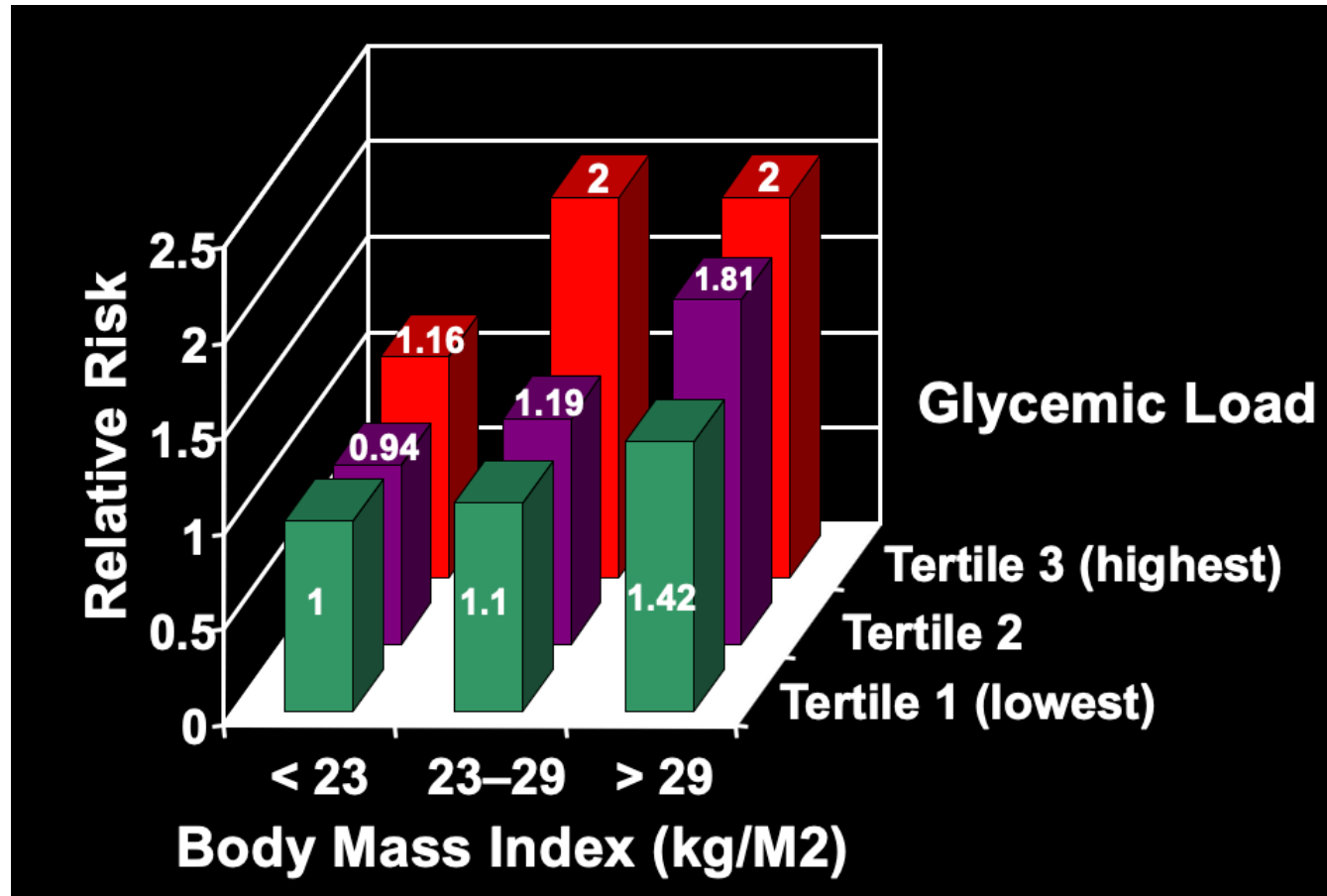
Meta-analysis of Glycemic Index and Diabetes, High vs. Low Intake



Effect of Acarbose and Placebo on Cumulative Probability of Remaining Free of Diabetes Over Time

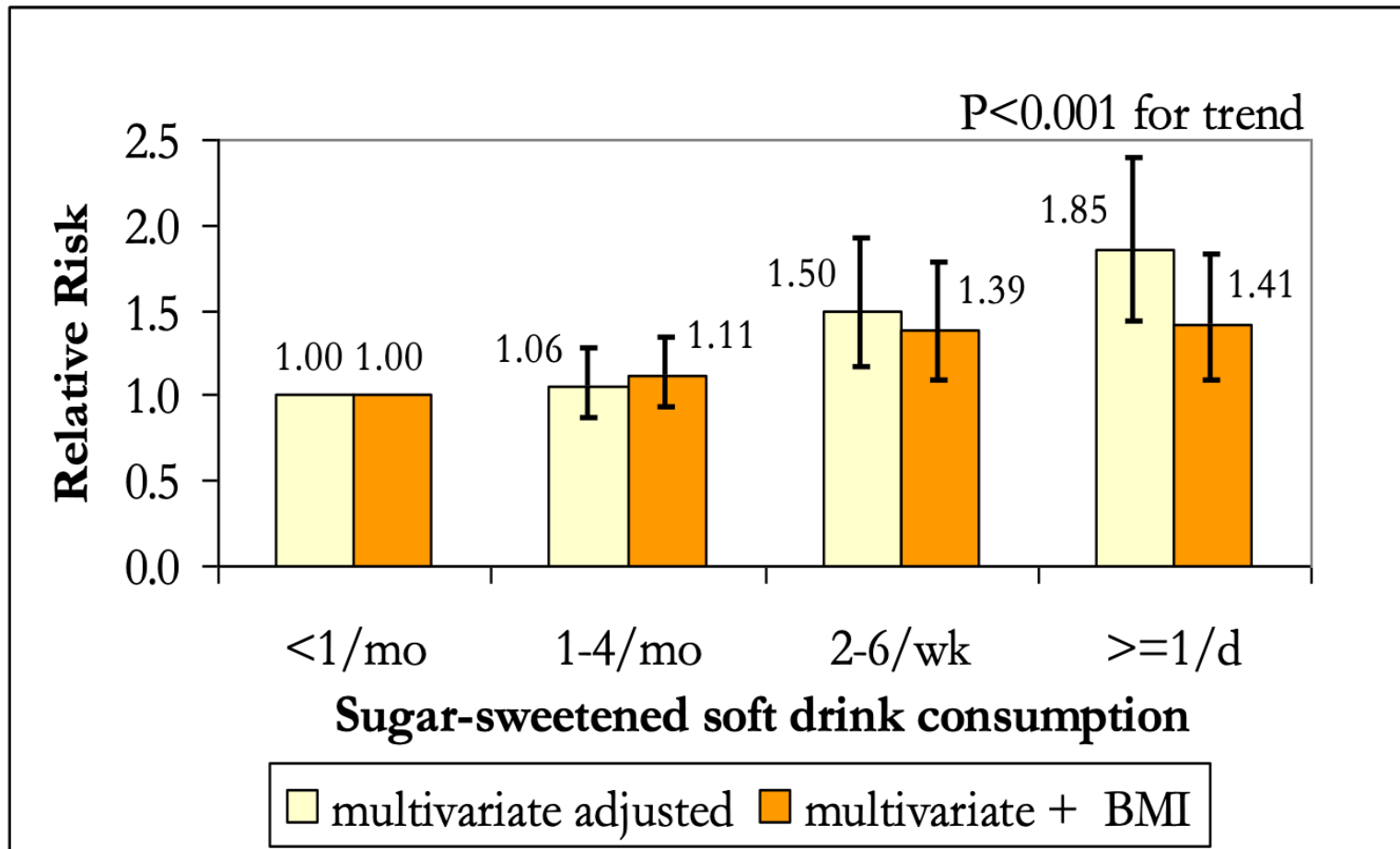


Relative Risk of Coronary Heart Disease



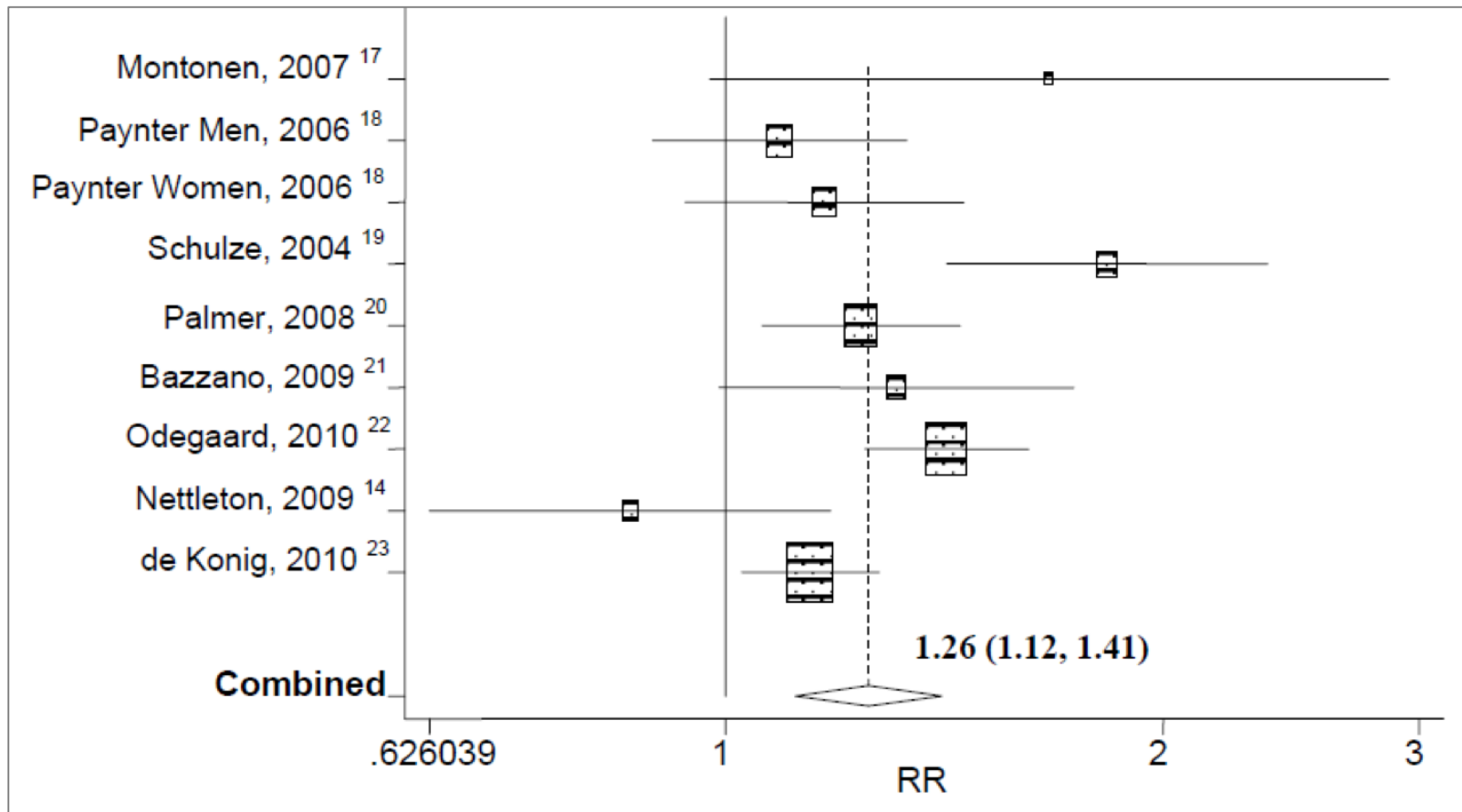
Liu, S et al. "A prospective study of dietary glycemic load, carbohydrate intake, and risk of coronary heart disease in US women." *The American Journal of Clinical Nutrition* June 2000; 71 (6),1455–1461, <https://doi.org/10.1093/ajcn/71.6.1455>

Regular Soft Drinks and Type 2 Diabetes, NHS2



(Schulze et al. 2004 JAMA)

Meta-analysis of Prospective Studies on Sugar-sweetened Beverages and Type 2 Diabetes Risk



Malik, V et al. "Sugar-Sweetened Beverages and Risk of Metabolic Syndrome and Type 2 Diabetes." *Diabetes Care* 2010 33 (11): 2477–2483

Traditional and Modern Corn



Courtesy of Target.com and Pioneer Seeds

Percentage of Type 2 Diabetes Potentially Preventable by Simultaneous Reduction of Five Modifiable Risk Factors (NHS)

Low Risk

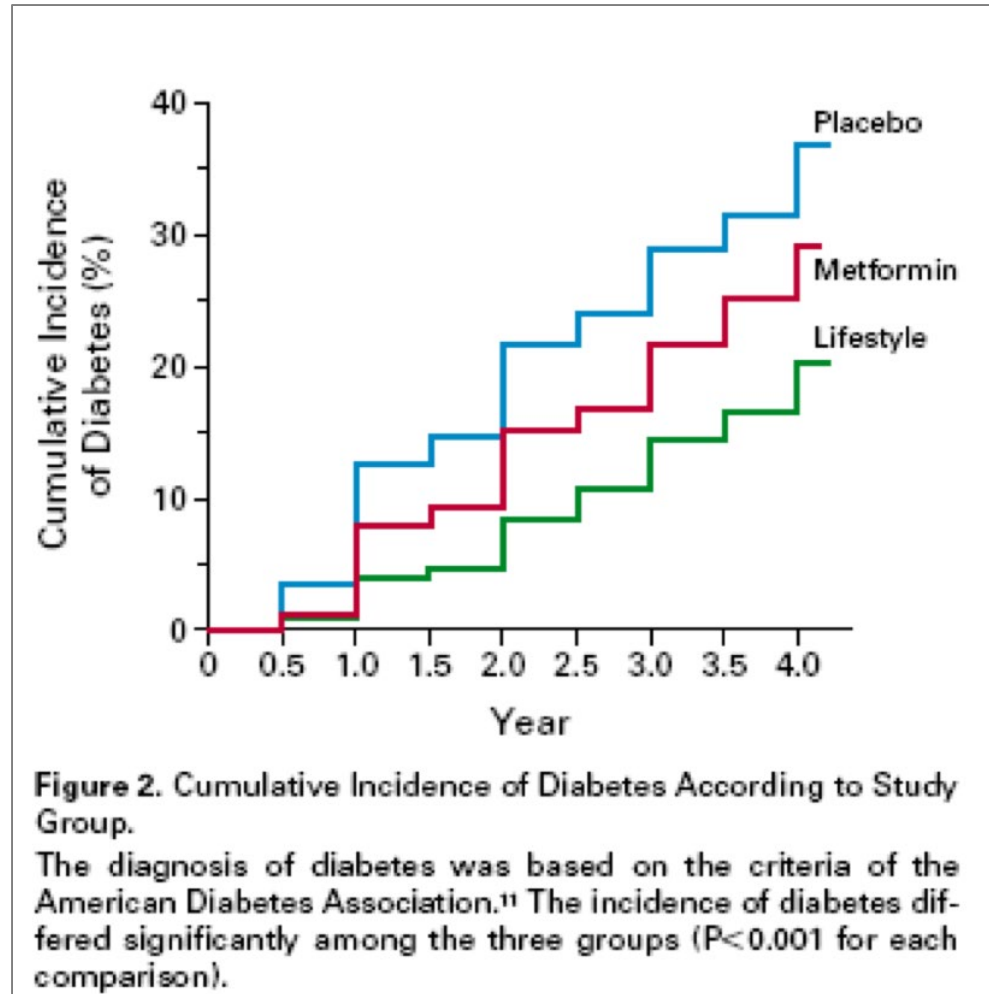
1. Nonsmoking
2. BMI < 25
3. Moderate to vigorous exercise
4. Diet score in upper 40% (low trans fat, high cereal fiber, low glycemic load, high P:S ratio)
5. Alcohol 5+ grams/day

Percent in low risk group: 4.1%

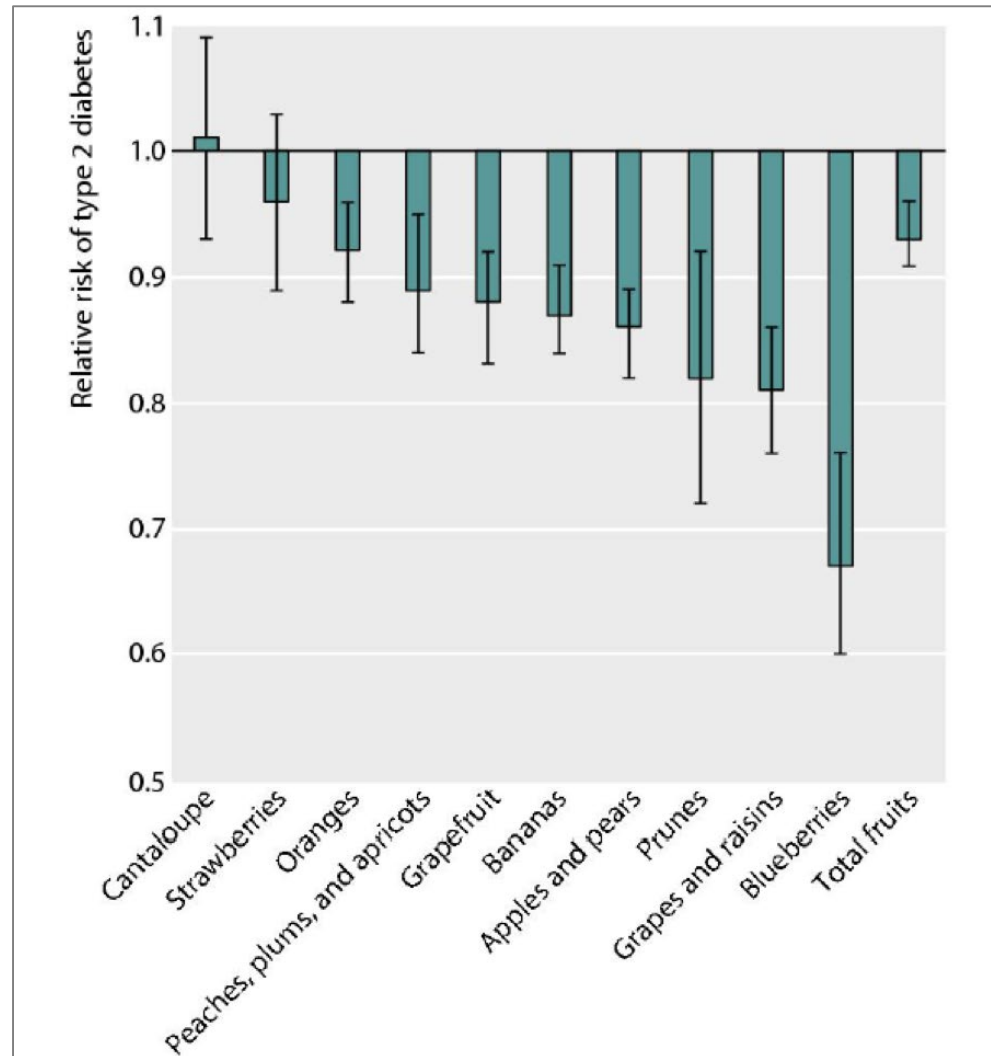
Population attributable risk (PAR): 92% (82–96)

(Hu et al.)

Cumulative Incidence of Diabetes According to Study Group



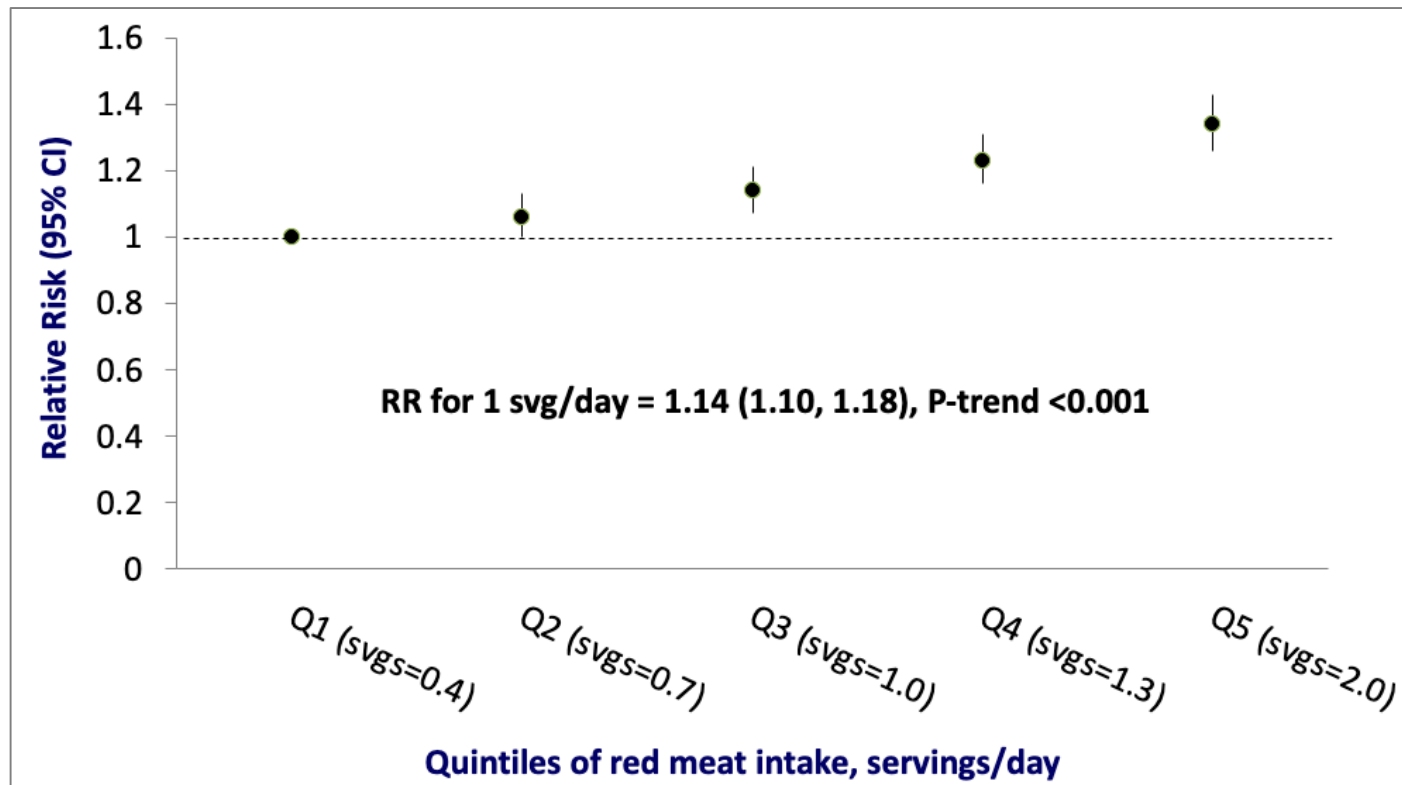
Relative Risk of Type 2 Diabetes for Substitution of Specific Fruits (3 Servings per Week) for Fruit Juice



(Muraki, I., et al. "Fruit consumption and risk of type 2 diabetes: results from three prospective longitudinal cohort studies" *BMJ* 2013; 347 <https://doi.org/10.1136/bmj.f5001>)

Relation of Red Meat to Risk of Type 2 Diabetes in NHS, NHSII, and HPFS

(204,156 men and women, 13,759 incident cases)

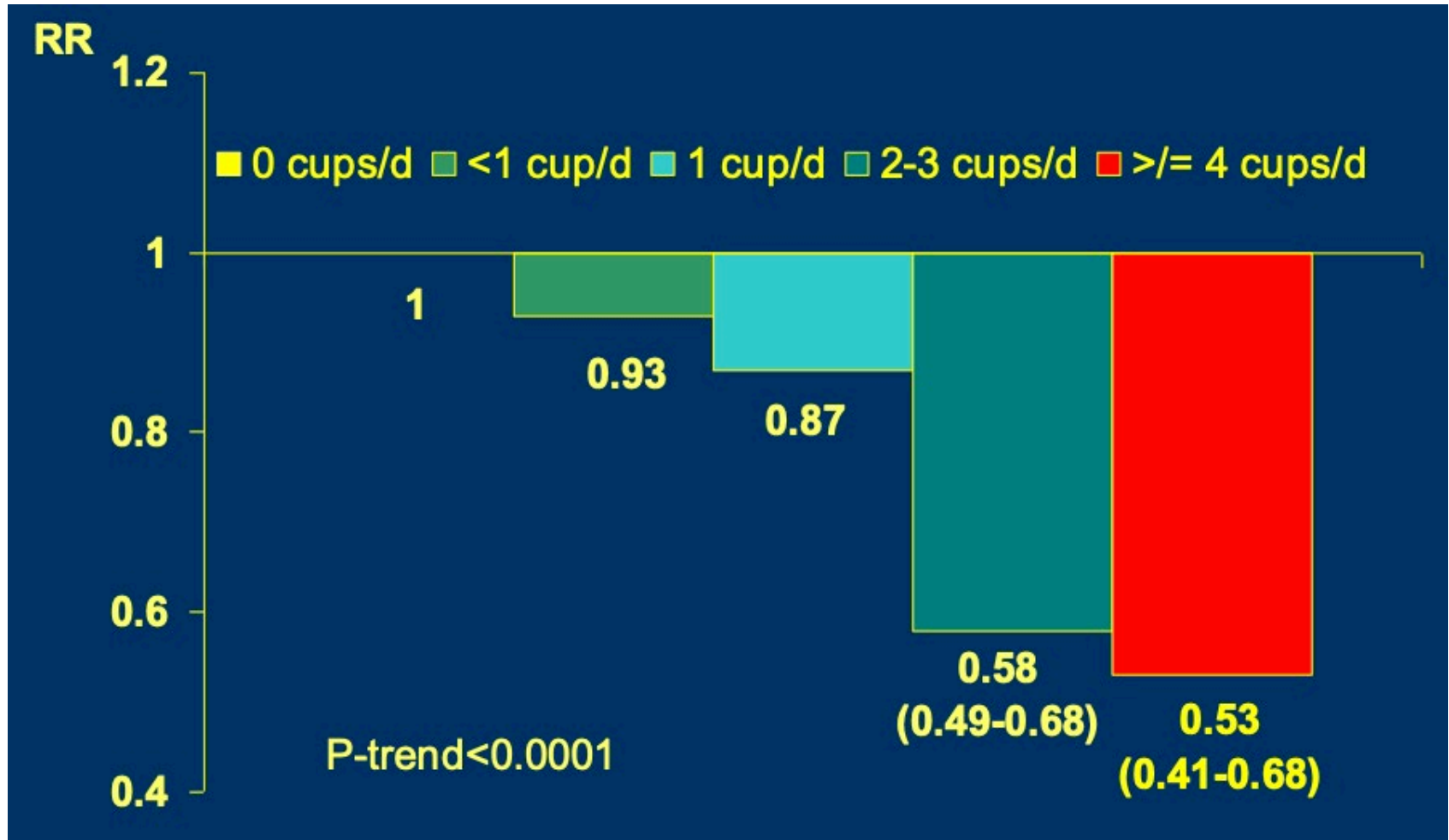


*Servings are average for 3 cohorts, considering 85 g/svg (3%)

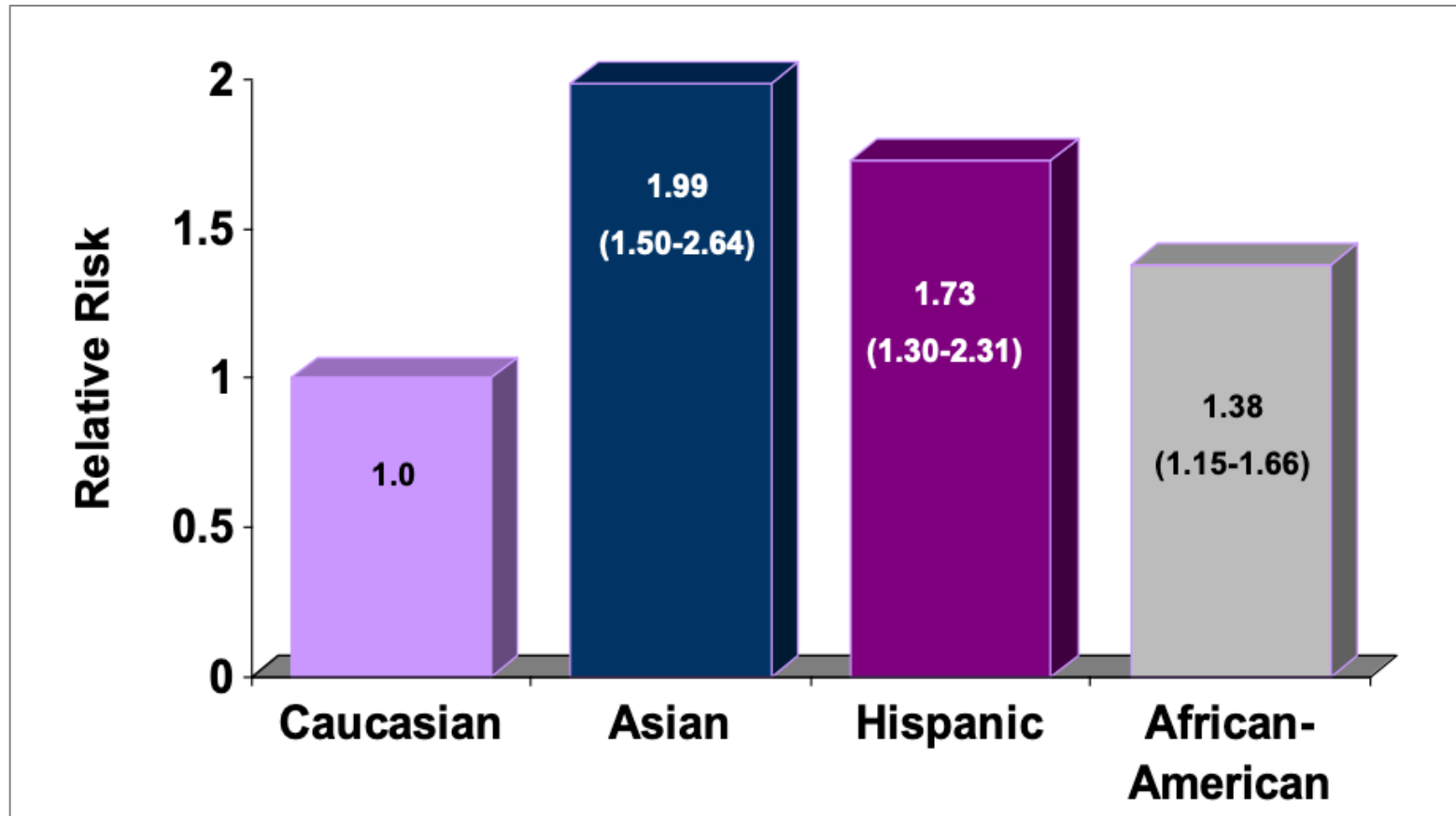
**N.B. Intake of red meat in “optimal diet” = 19 g/day (Micha, R, et al. “Etiologic effects and optimal intakes of foods and nutrients for risk of cardiovascular diseases and diabetes: Systematic reviews and meta-analyses from the Nutrition and Chronic Diseases Expert Group (NutriCoDE).” PLoS One 2017)

(Pan, A., et al. “Red meat consumption and risk of type 2 diabetes: 3 cohorts of US adults and an updated meta-analysis” American Journal of Clinical Nutrition 2011)

Coffee Consumption and Risk of Type 2 Diabetes in U.S. Women

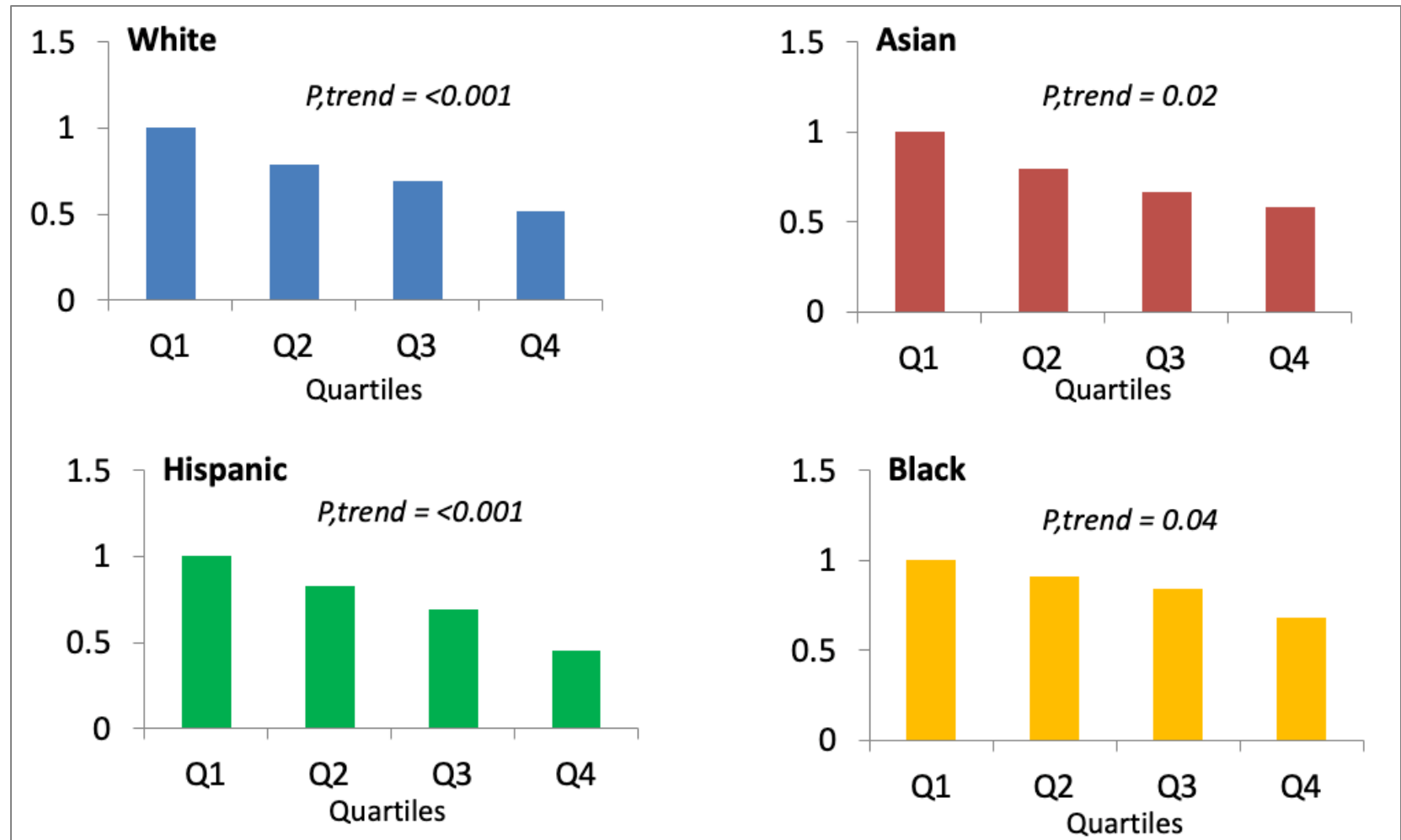


RR of Type 2 Diabetes Adjusted for BMI and Dietary and Lifestyle Variables



(Shai, I., "Ethnicity, Obesity, and Risk of Type 2 Diabetes in Women A 20-year follow-up study." *Diabetes Care*, 2006)

Diabetes Dietary Risk Reduction Score and Incidence of T2DM in NHS and NHS II by Ethnicity



Rhee. J., et al., "Dietary Diabetes Risk Reduction Score, Race and Ethnicity, and Risk of Type 2 Diabetes in Women." *Diabetes Care* 2015; 38(4): 596–603

Conclusions

- Type 2 diabetes is rapidly increasing throughout the world
- Type 2 diabetes is almost entirely preventable by modification of known risk factors
- Modifying these risk factors will require layers of behavioral and policy changes at all levels, but this must be a high national and international priority