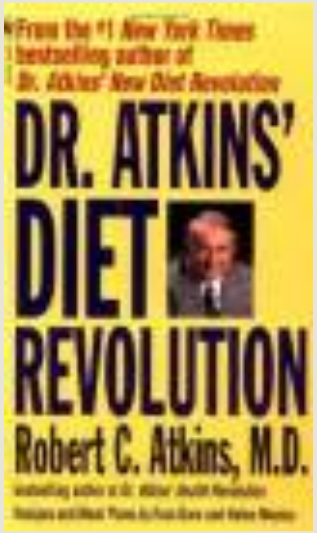
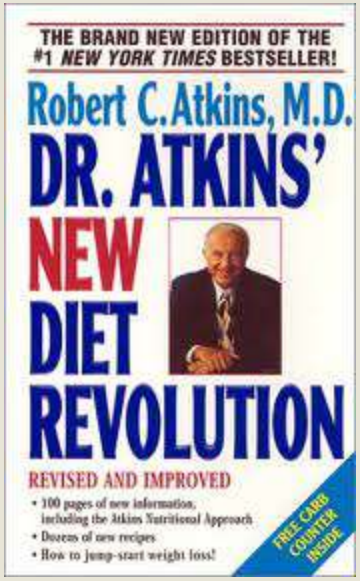
Can a Gluten-Free Diet be Hazardous to Your Health?

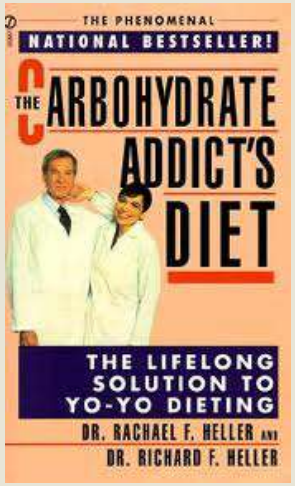
77th World Bread Congress
Merida, Mexico
October 3, 2017

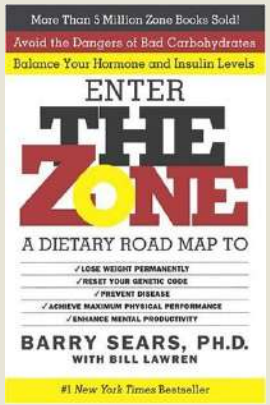
Glenn Gaesser, PhD
Professor, Arizona State University
Phoenix, AZ

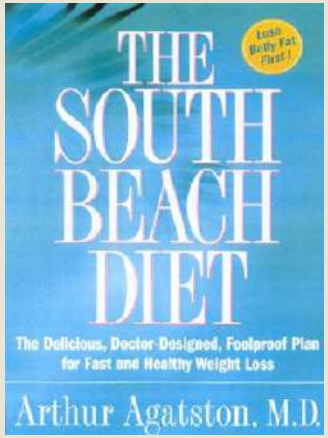
Challenges to Grain (Wheat) Consumption

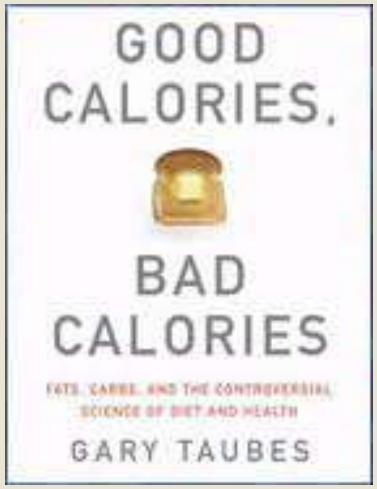


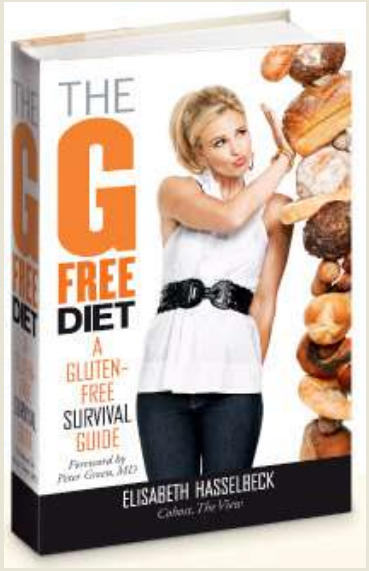


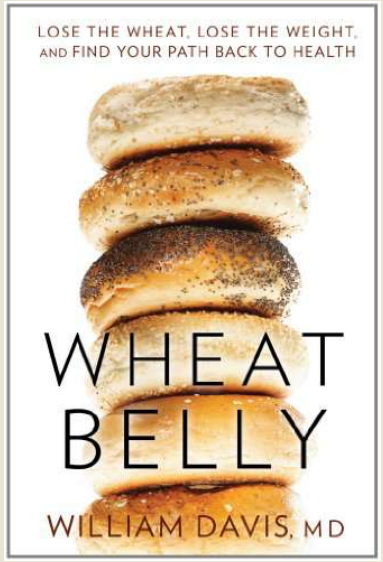








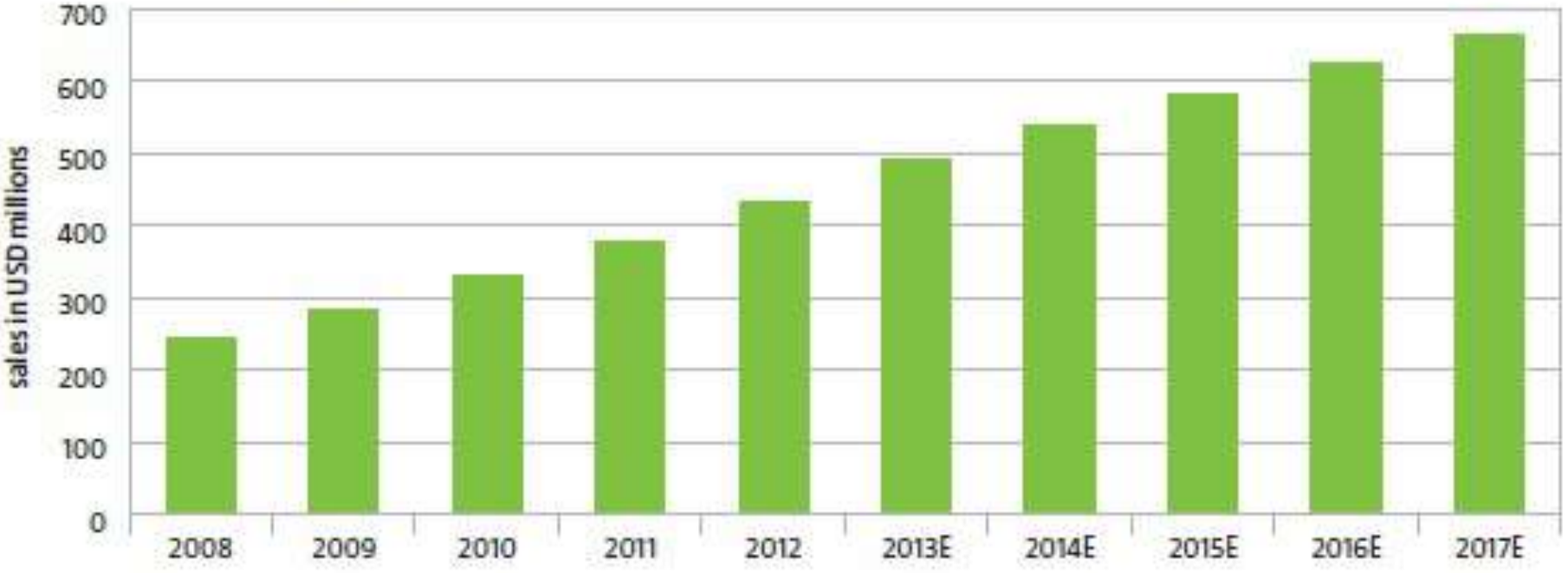




Gluten-free diets have become immensely popular in the United States. Despite <1% of Americans having diagnosed celiac disease, an estimated 25% of American consumers reported consuming gluten-free food in 2015, a 67% increase from 2013.

Rubio-Tapia et al, *Am J Gastroenterol,* 2012;107:1538-1544
Mintel Group, Ltd. August 2016

Projected sales of gluten-free food products in North America



Source: Euromonitor, Boulder Brands company reports; 2008–2012 CAGR 12.1%; 2012–2017E CAGR 8.9%

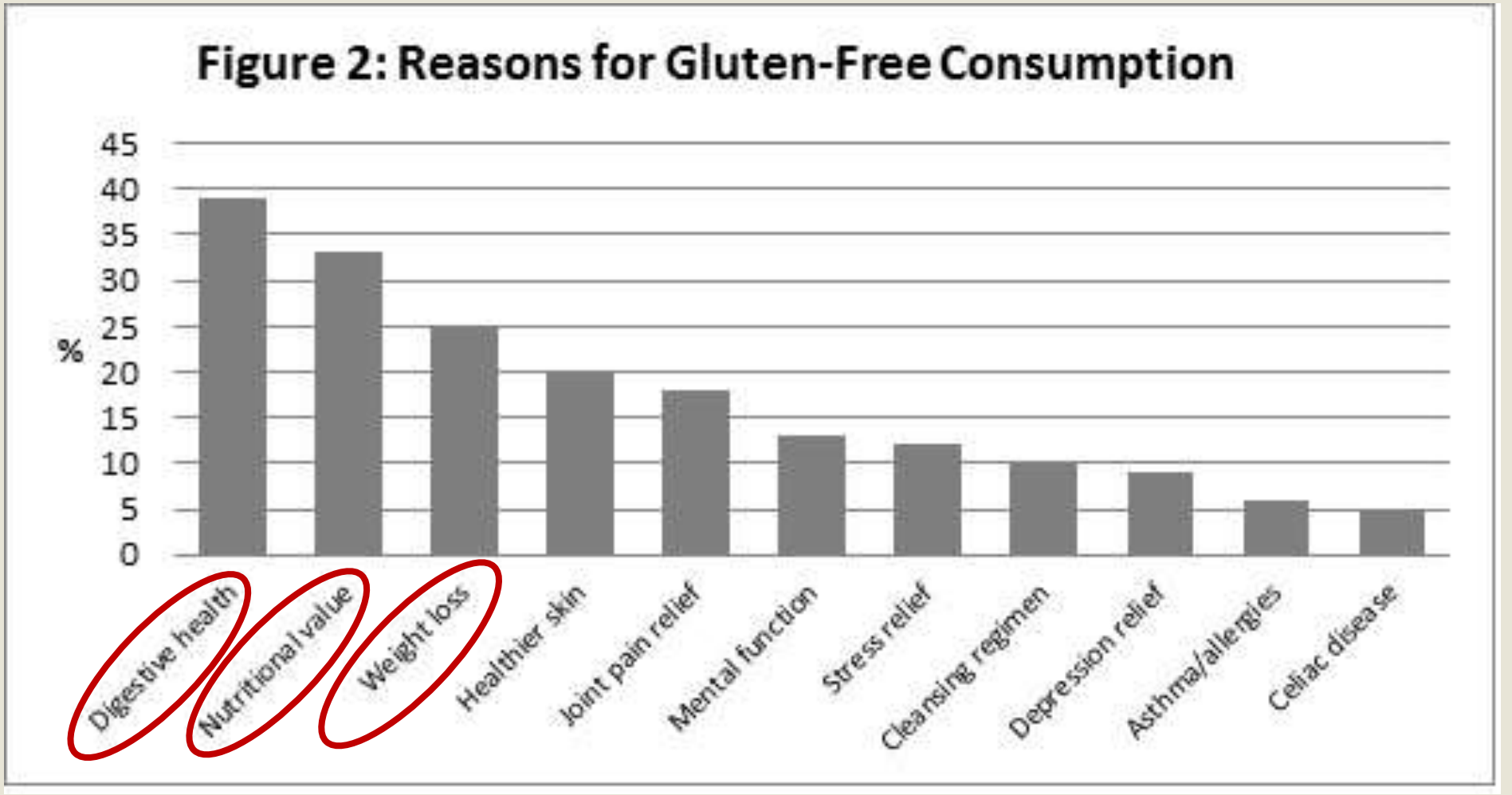


Figure 2: Reasons for Gluten-Free Consumption
%
45
40
35
30
25
20
15
10
5
0
Digestive health
Nutritional value
Weight loss
Healthier skin
Joint pain relief
Mental function
Stress relief
Cleansing regimen
Depression relief
Asthma/allergies
Celiac disease

RESEARCH
Commentary

Gluten-Free Diet: Imprudent Dietary Advice for the General Population?

Glenn A. Gaesser, PhD; Siddhartha S. Angadi, PhD

J Acad Nutr Diet 2012;112:1330-1333

"There is no evidence to suggest that following a gluten-free diet has any significant benefits in the general population."

Claims Against Wheat

- Gluten levels in wheat have increased
- "Old" wheats were less toxic
- Short (dwarf) wheat is a product of genetic research in the 1960s and 1970s (there is no GMO wheat on the market)
  - Height genes do not code for glutenins and gliadins
- Gliadin is a opiate that stimulates appetite

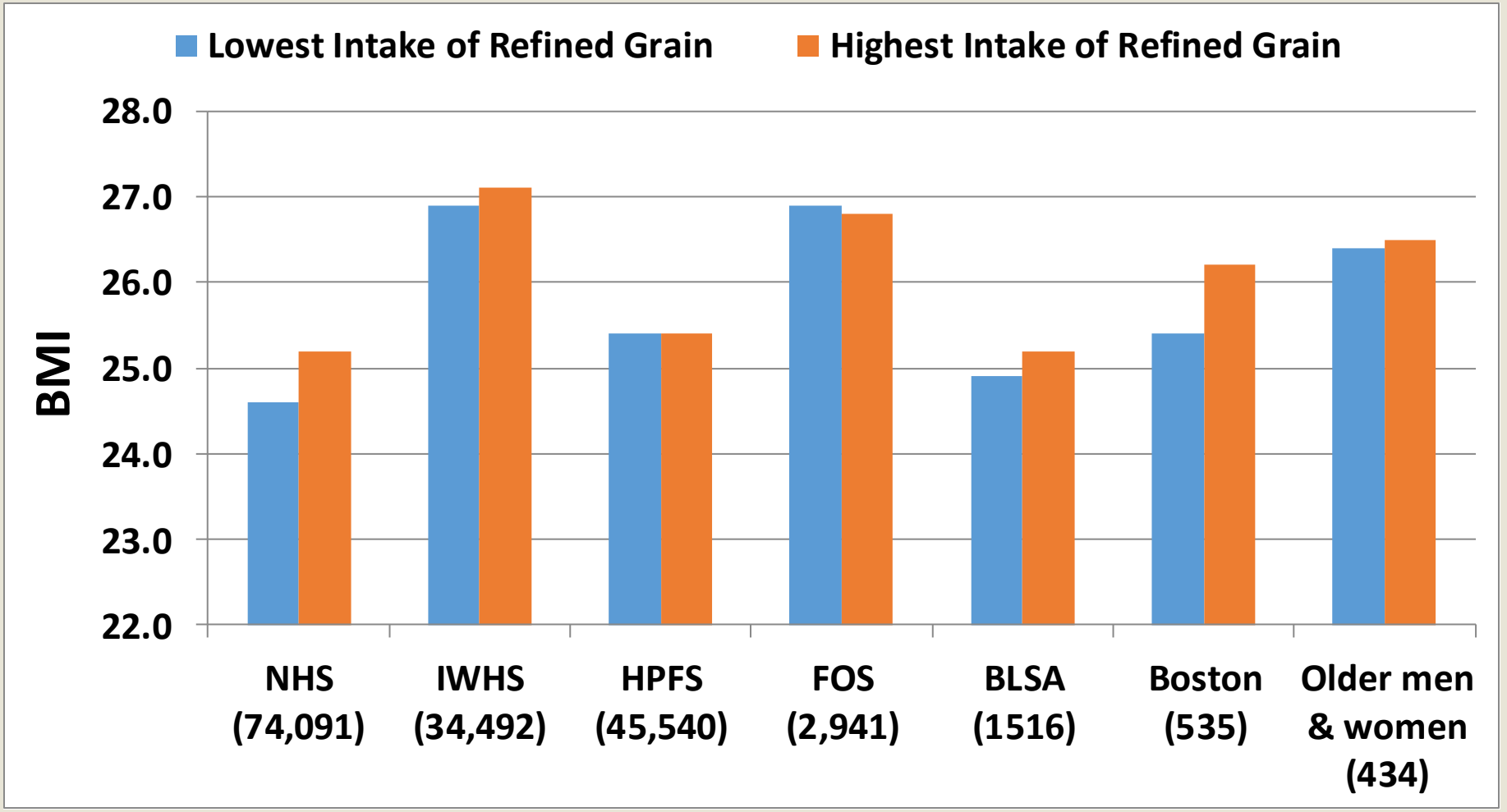
Gluten Levels in Wheat Have not Increased

- Gluten levels in various wheat varieties have changed little on average since the 1920s.
  - Gluten addition to breads and foods has increased

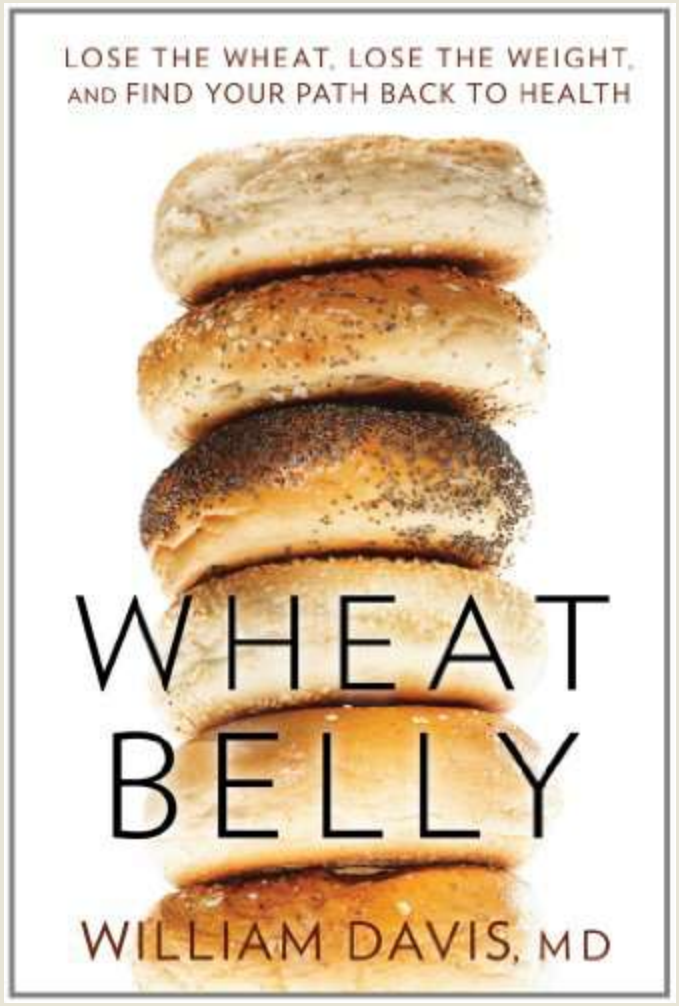
Kasarda DD. *J Agric Food Chem*. 2013;61:1155-9

Can Wheat / Grains / Carbohydrates / Bread Explain the Increased Obesity Prevalence Over the Past Three Decades?

Refined Grain Intake and Body Mass Index
U. S. Cohort Studies



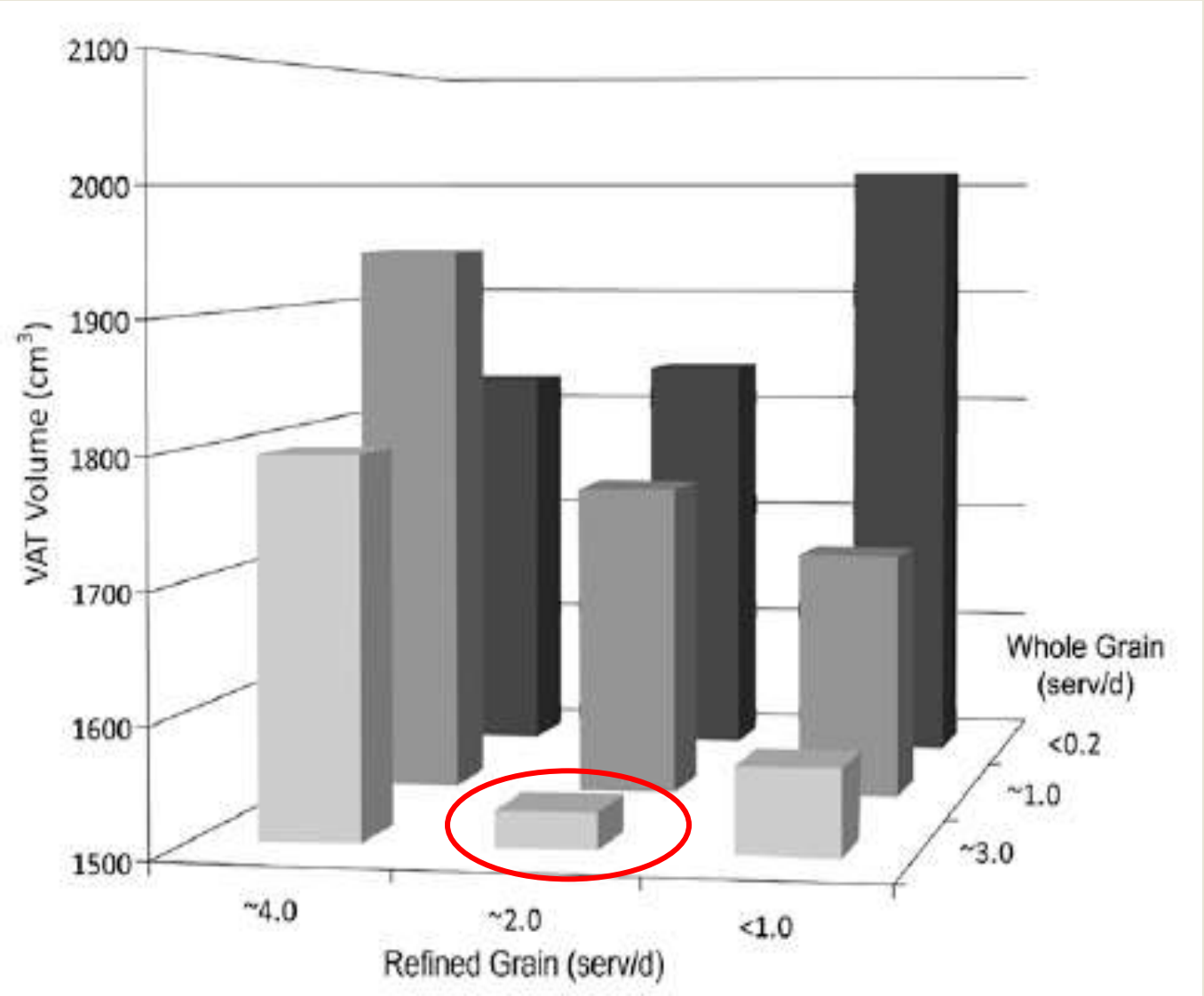
Adapted from Gaesser, *JADA* 2007; 107:1768-1780



Despite the Assertion…

Grain Consumption is <u>not associated</u> with high levels of Belly Fat

Grain Intake and Visceral Abdominal Fat



Framingham Heart Study (n=2834)

McKeown et al. *Am J Clin Nutr* 2010; 92:1165-71

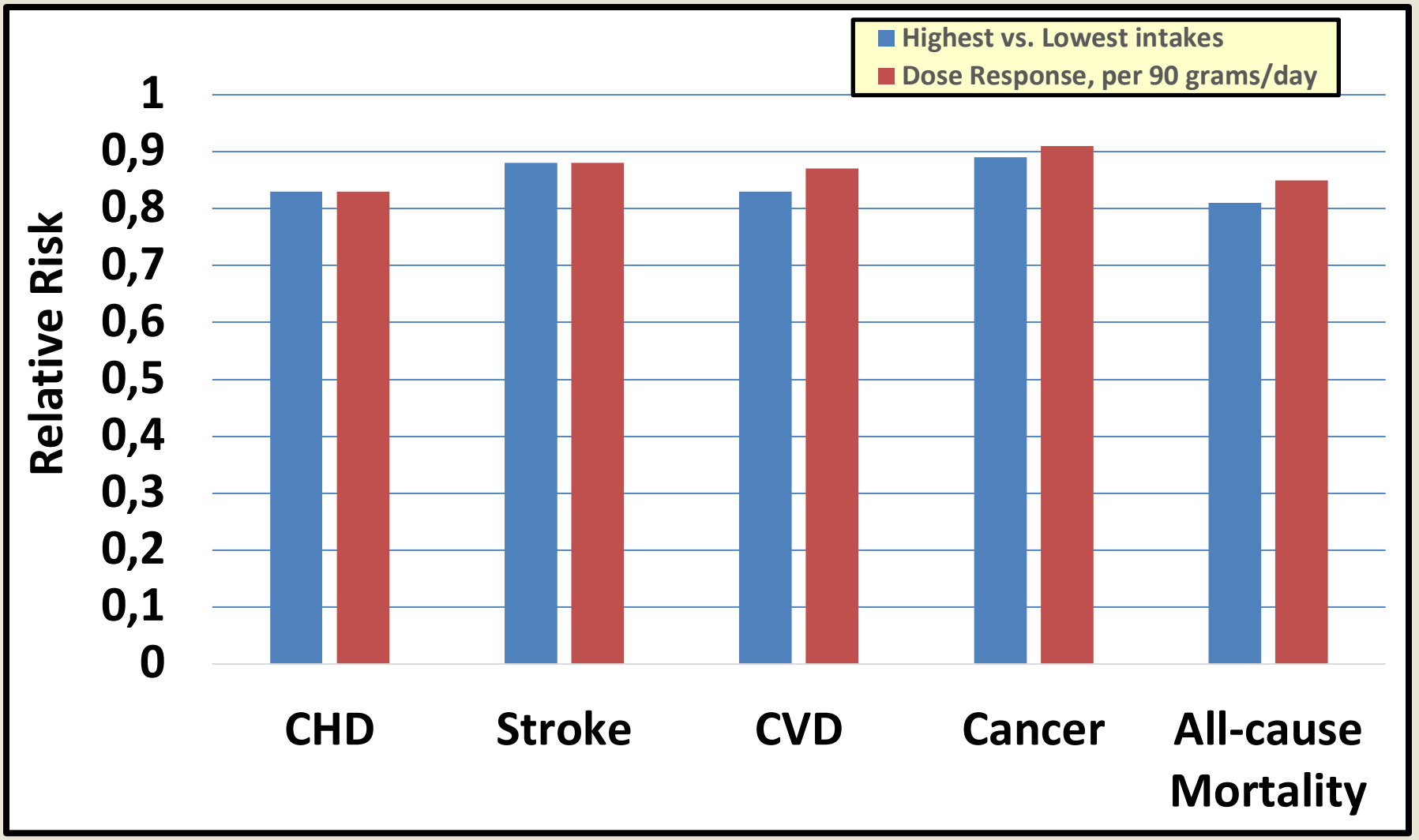
Whole grain consumption and risk of cardiovascular disease, cancer, and all cause and cause specific mortality: systematic review and dose-response meta-analysis of prospective studies

Dagfinn Aune,[1, 2] NaNa Keum,[3] Edward Giovannucci,[3, 4, 5] Lars T Fadnes,[6] Paolo Boffetta,[7] Darren C Greenwood,[8] Serena Tonstad,[9] Lars J Vatten,[1] Elio Riboli,[2] Teresa Norat[2]

Specific analyses on bread were included in this paper

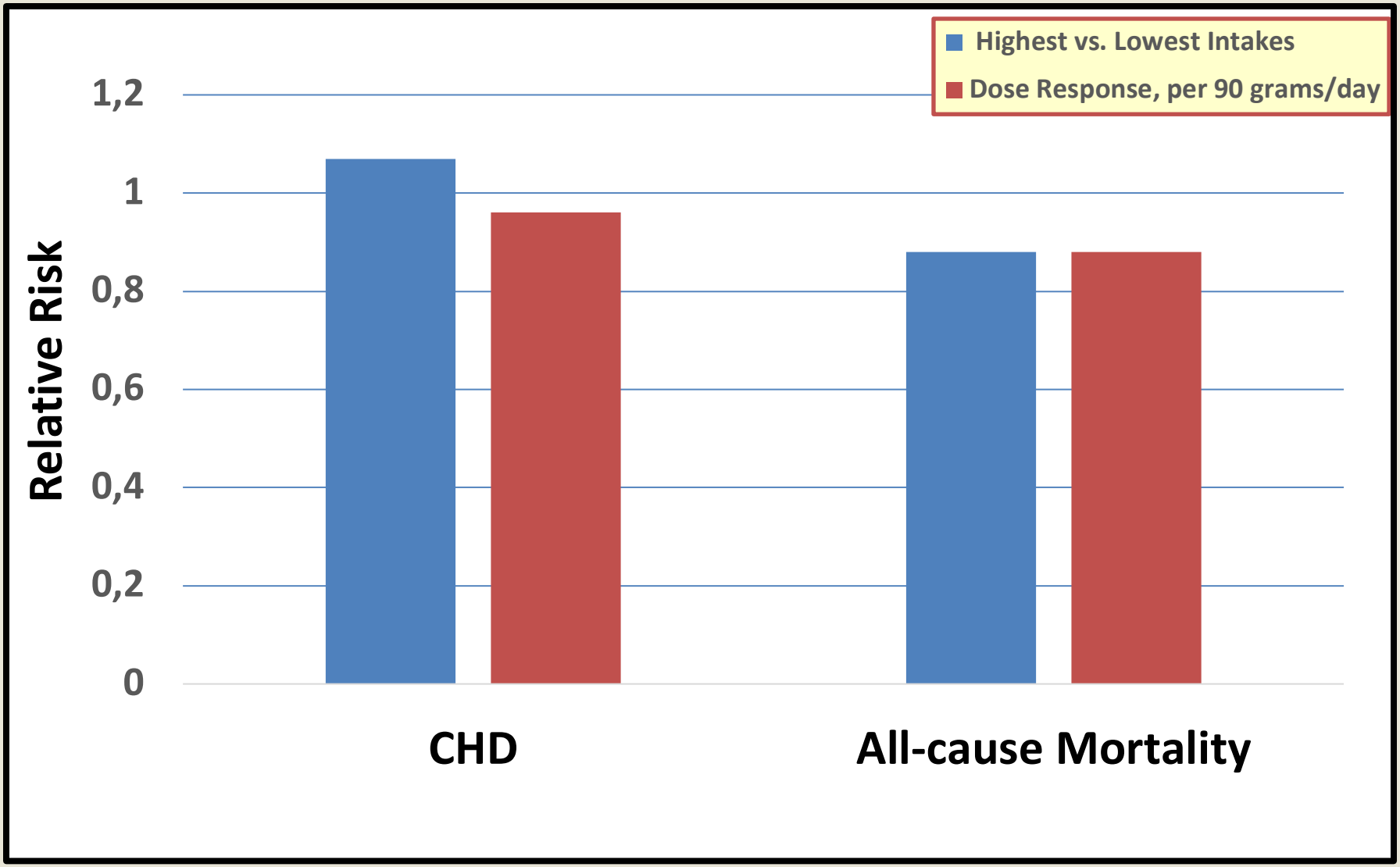
***BMJ,* 2016;353:i2716**

Whole-grain Bread Intake and Relative Risk of Chronic Disease



Aune et al, *BMJ* 2016;353:i2716

White Bread Intake and Relative Risk of CHD
Total Bread Intake and All-cause Mortality Risk



Aune et al, *BMJ* 2016;353:i2716

Changes in Bread Consumption and 4-year Changes in Adiposity in Spanish Subjects at High Cardiovascular Risk

PREDIMED Trial

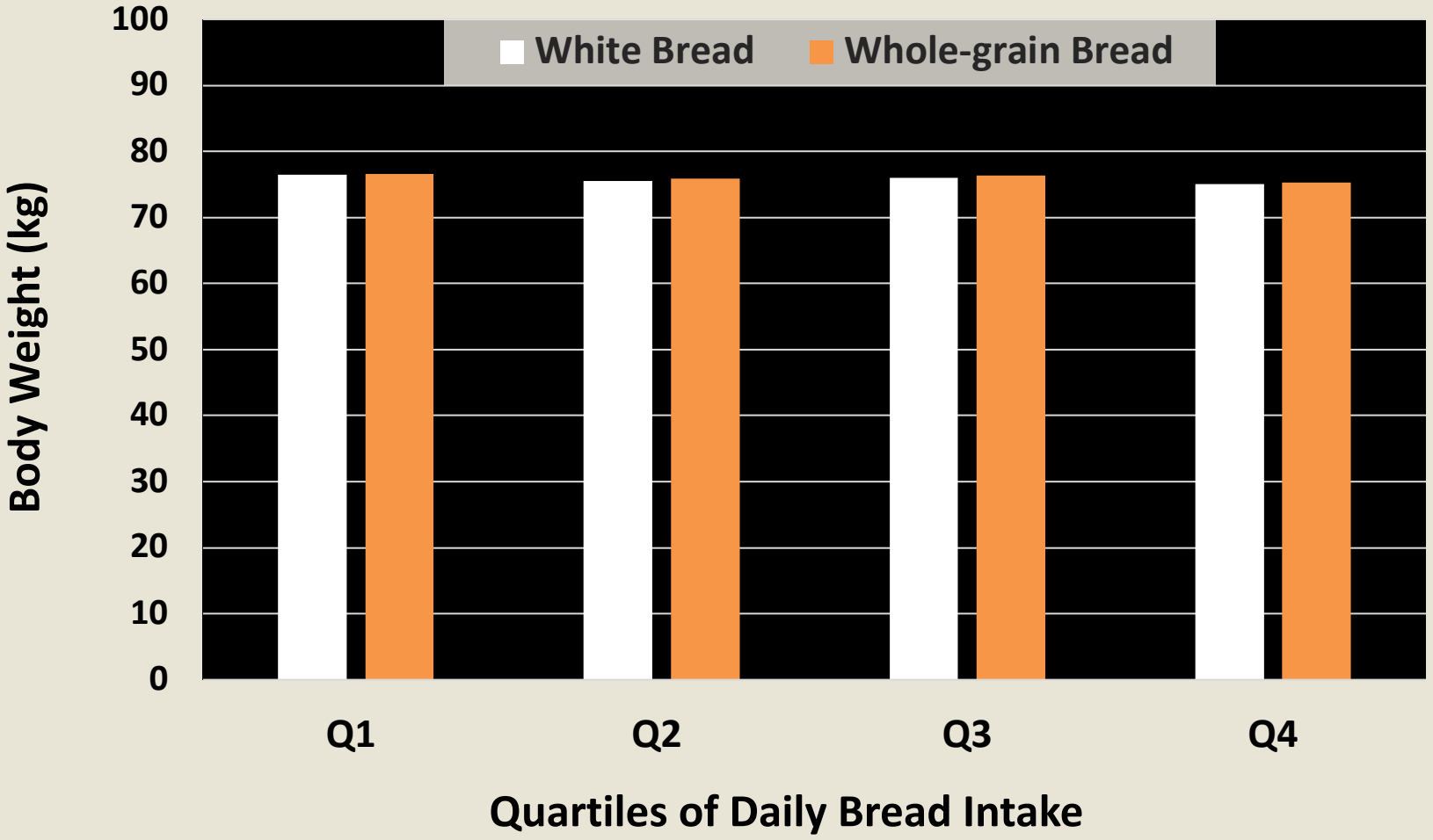
Conclusion of authors:

"the results of the present study show that decreasing total and white bread and maintaining wholegrain bread consumption in the setting of a Mediterranean-style diet could help in reducing weight and abdominal fat gain"

But….is the magnitude of the "effect" clinically meaningful?

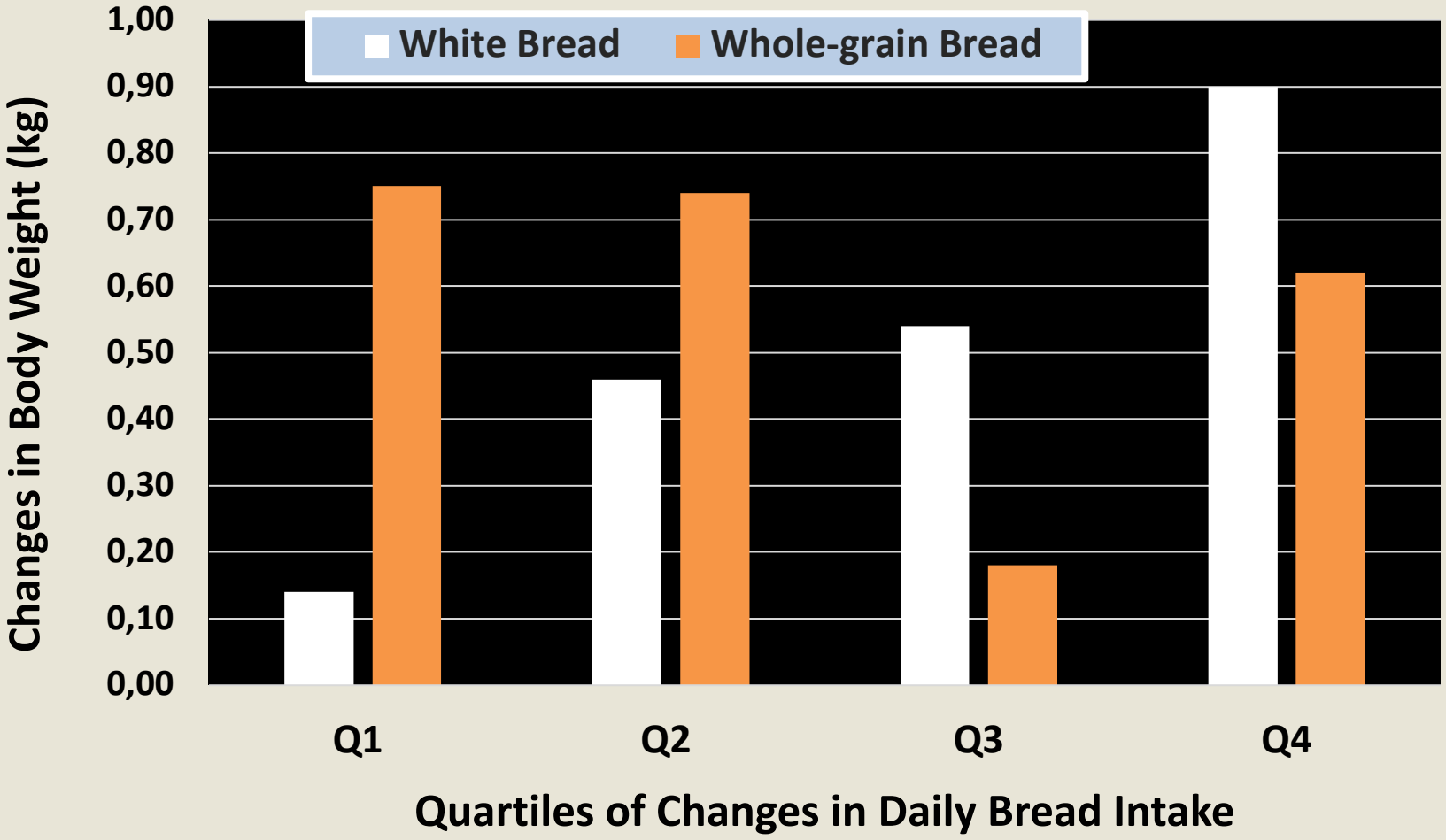
Bautisto-Castano et al, *Brit J Nutr* 2013; 110:337-346

Baseline Body Weight by Quartile of Bread Consumption [PREDIMED Trial – 2,213 Participants]



Bautisto-Castano et al, *Brit J Nutr* 2013; 110:337-346

4-Year Changes in Body Weight by Quartile of Change in Bread Consumption [PREDIMED Trial – 2,213 Participants]



Bautisto-Castano et al, *Brit J Nutr* 2013; 110:337-346

In Perspective…comparing Q1 and Q4 of changes in white bread consumption

	Change in intake (g/d)	Change in intake over 4 years (kg)*	Change in body weight over 4 years (kg)
White Bread (Q1)	-108	-158	0.14
White Bread (Q4)	+87	+127	0.90

*g/d x 365 d/yr divided by 1000 g/kg

A difference of 285 kg (627 pounds!)of bread consumption over 4 years resulted in a difference of only 0.76 kg of body weight gain (i.e., 0.90 – 0.14 kg) (~1.7 pounds)

Bautisto-Castano et al, *Brit J Nutr* 2013; 110:337-346

Conclusion of authors:

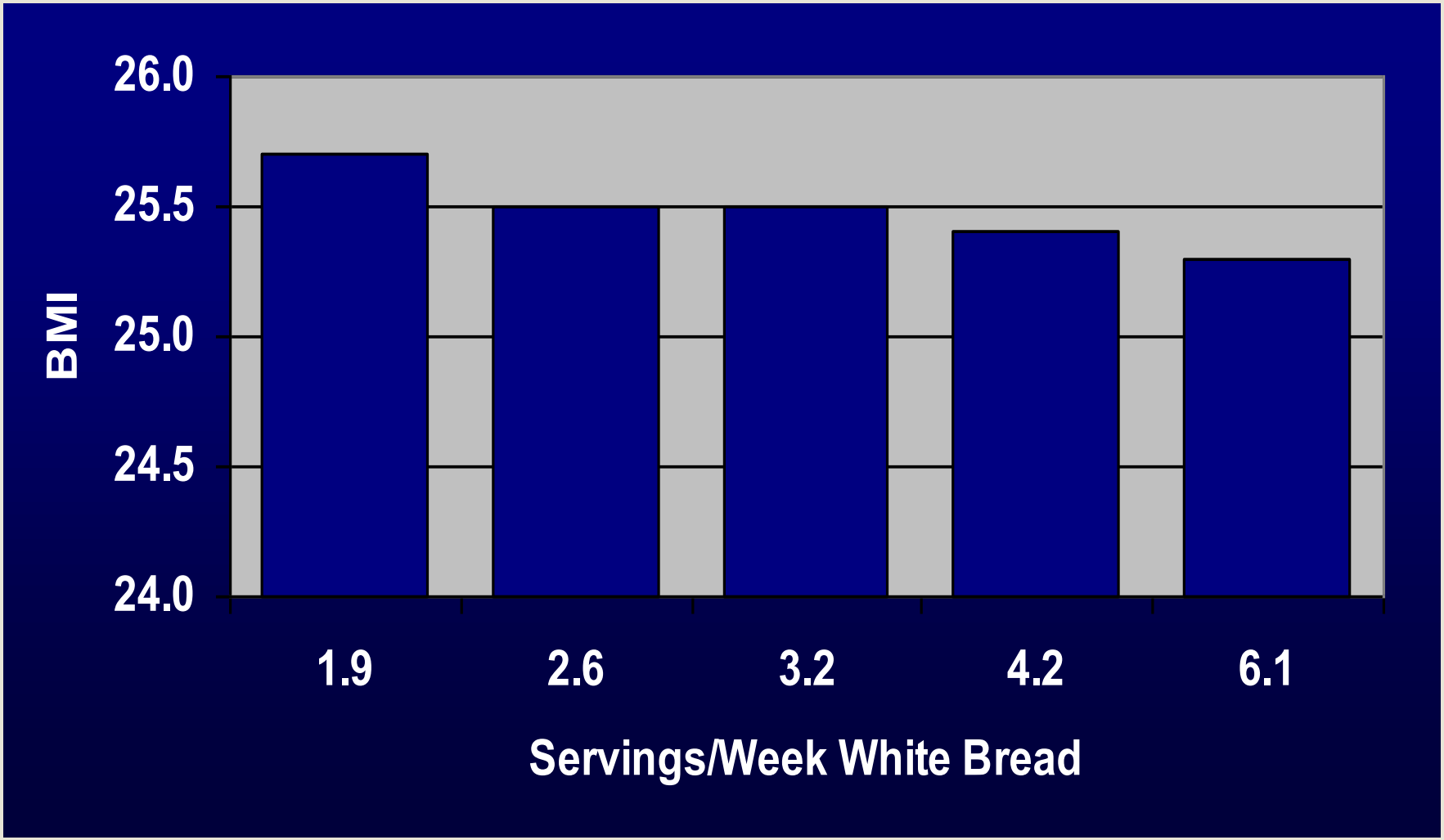
"the results of the present study show that decreasing total and white bread and maintaining wholegrain bread consumption in the setting of a Mediterranean-style diet could help in reducing weight and abdominal fat gain"

Alternative Conclusion:

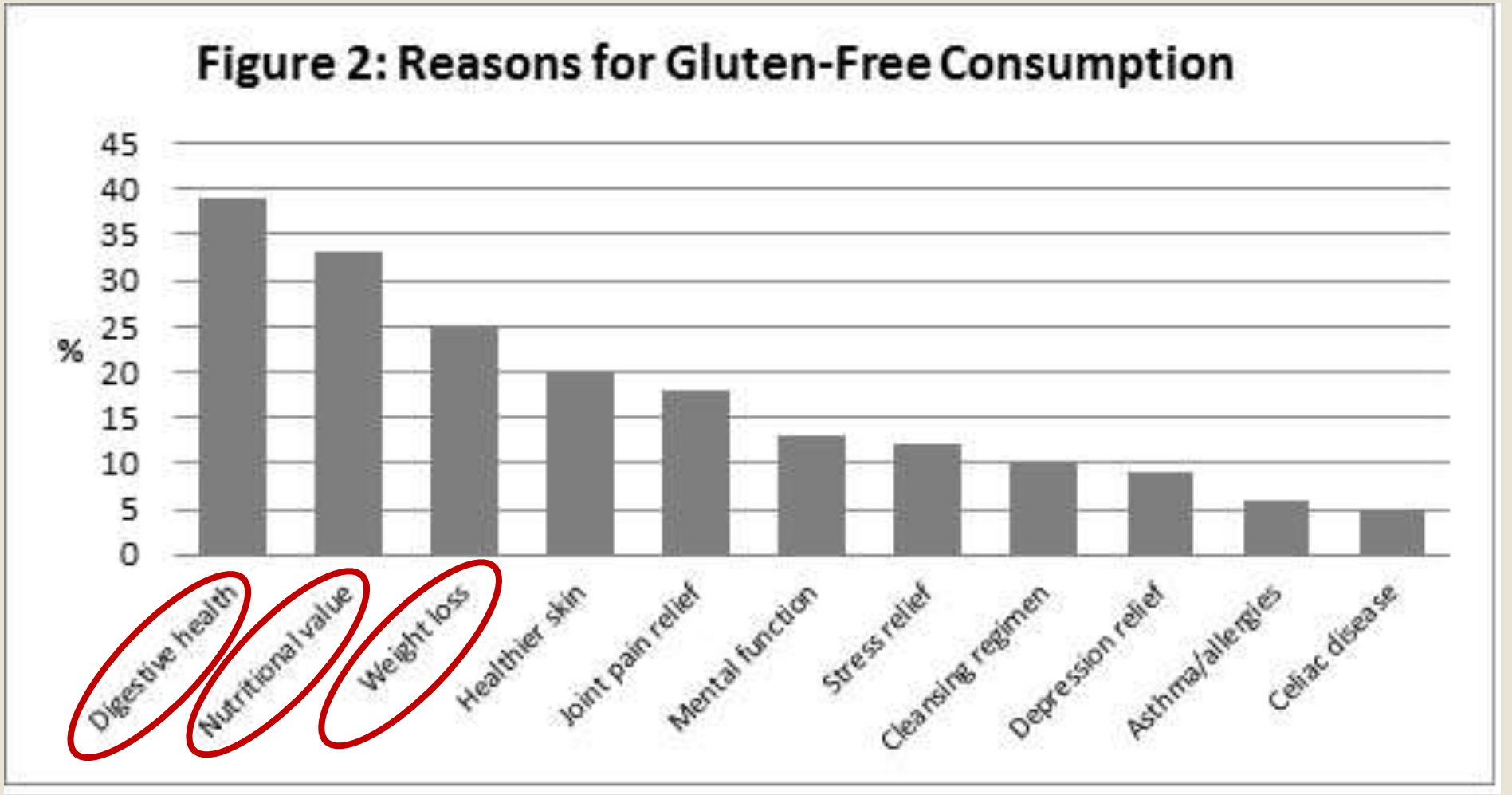
Changes in bread consumption appear to have rather modest effects on changes in body weight over a 4-year period

Bautisto-Castano et al, *Brit J Nutr* 2013; 110:337-346

White Bread Consumption and Body Mass Index: Health Professionals Follow-Up Study (n= 42,759)



Salmeron et al, *Diabetes Care* 1997; 20: 545-550.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Weight loss
Healthier skin
Joint pain relief
Mental function
Stress relief
Cleansing regimen
Depression relief
Asthma/allergies
Celiac disease

Long term gluten consumption in adults without celiac disease and risk of coronary heart disease: prospective cohort study

Benjamin Lebwohl,[1,2] Yin Cao,[3,4,5] Geng Zong,[5] Frank B Hu,[5,6] Peter H R Green,[1] Alfred I Neugut,[1,2] Eric B Rimm,[5,6,7] Laura Sampson,[5] Lauren W Dougherty,[5] Edward Giovannucci,[5,6,7] Walter C Willett,[5,6,7] Qi Sun,[5,6] Andrew T Chan[3,4,6]

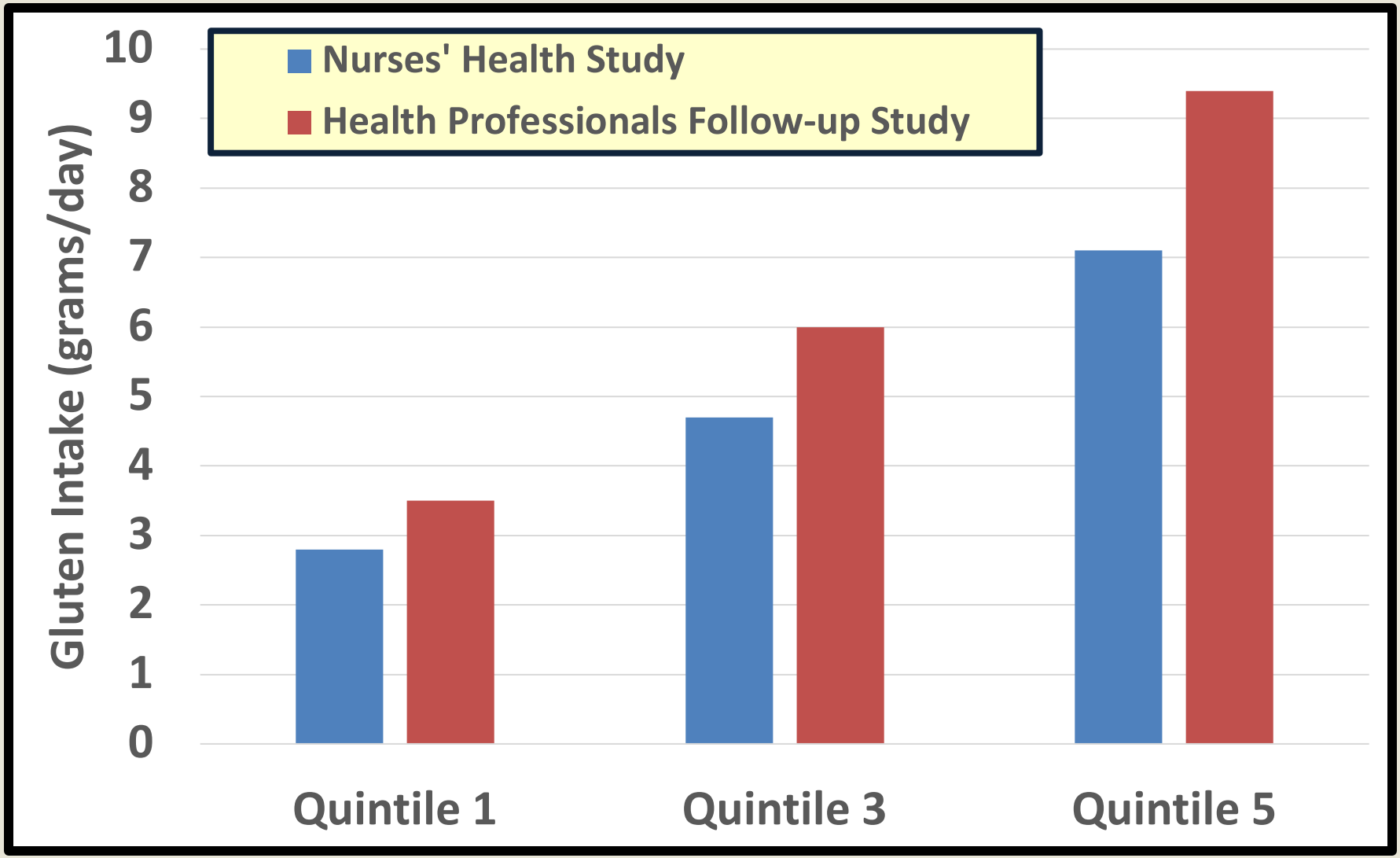
The objective of this study was to examine the association of long-term intake of gluten with the development of incident coronary heart disease

Lebwohl et al, *BMJ* 2017;357:j1892

SETTING AND PARTICIPANTS

64 714 women in the Nurses' Health Study and 45 303 men in the Health Professionals Follow-up Study without a history of coronary heart disease who completed a 131 item semiquantitative food frequency questionnaire in 1986 that was updated every four years through 2010.

Daily gluten intake



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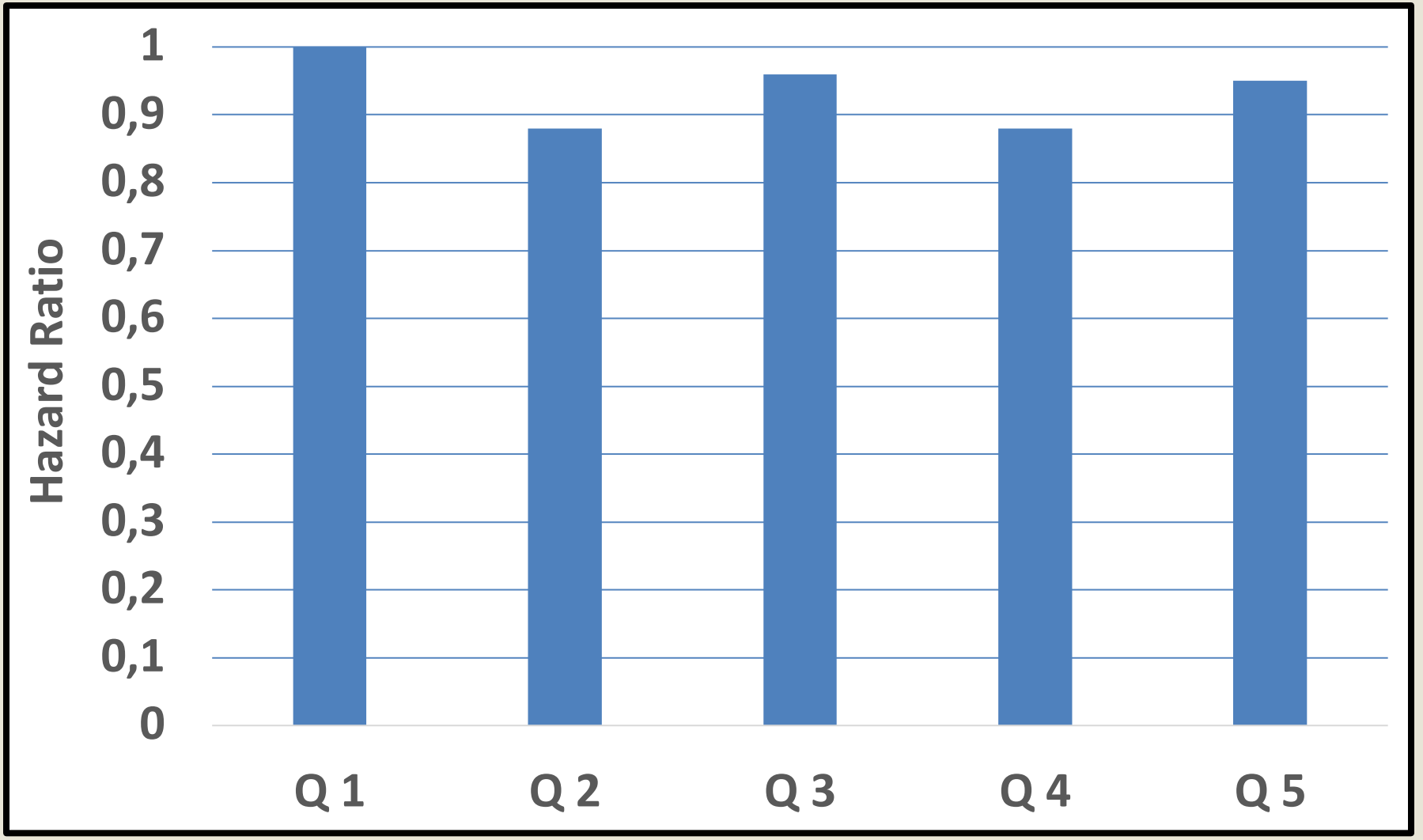
Gluten and risk of coronary heart disease, by quintile of gluten intake



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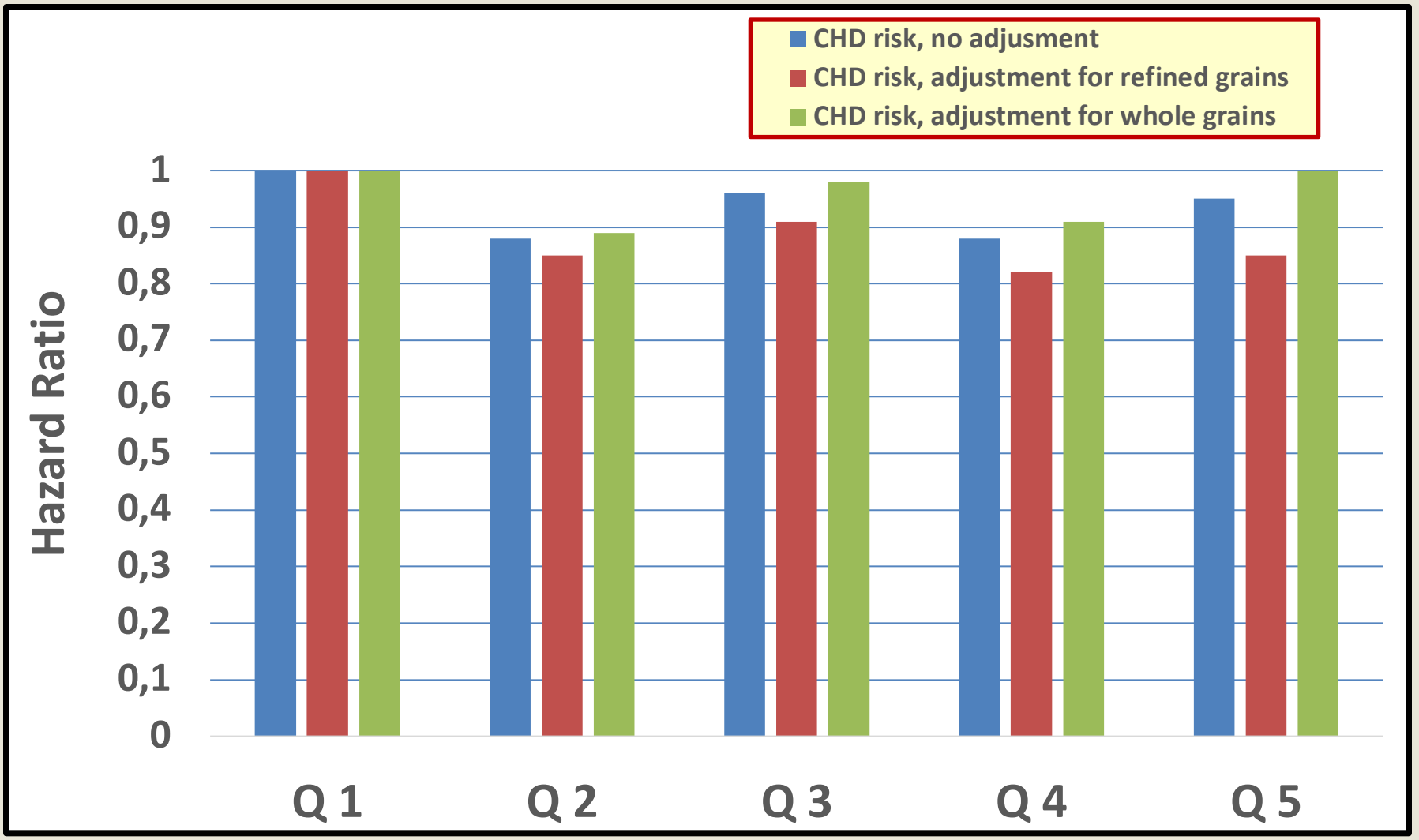


Lebwohl et al, *BMJ* 2017;357:j1892

Conclusions

Long term dietary intake of gluten was not associated with risk of coronary heart disease. However, the avoidance of gluten may result in reduced consumption of beneficial whole grains, which may affect cardiovascular risk. The promotion of gluten-free diets among people without celiac disease should not be encouraged.

The unintended consequences of a gluten-free diet

Recent report based on data from the National Health and Nutrition Examination Survey, 2009-2014

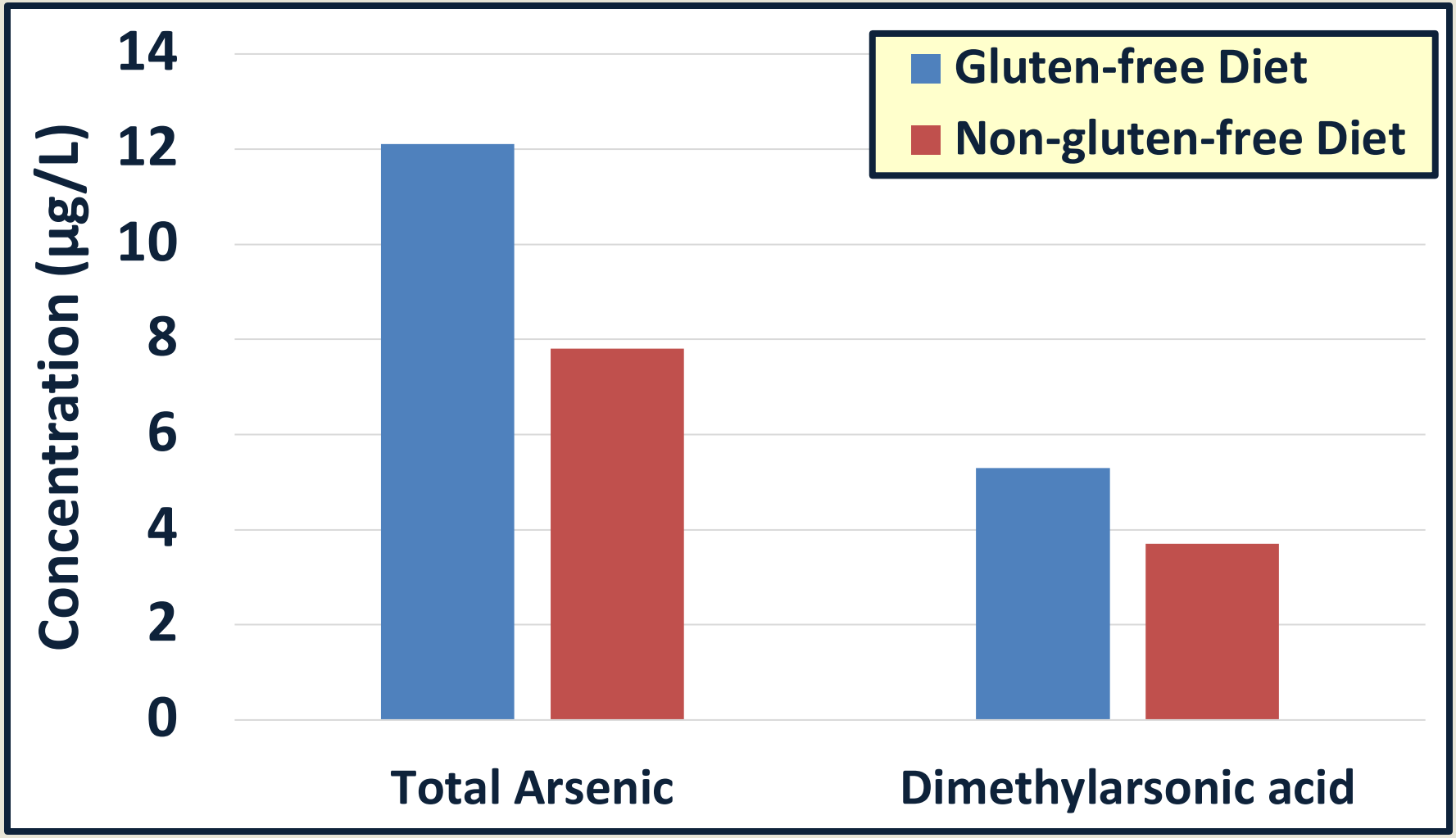
- **7,471 participants**
- **73 reported being on a gluten-free diet**

Bulka et al, *Epidemiol*, 2017;28:e24-e25

Commercial gluten-free products primarily contain rice flour as a substitute. Emerging evidence suggests rice-based products can contain high levels of toxic metals; rice is a recognized source of arsenic and methylmercury exposure.

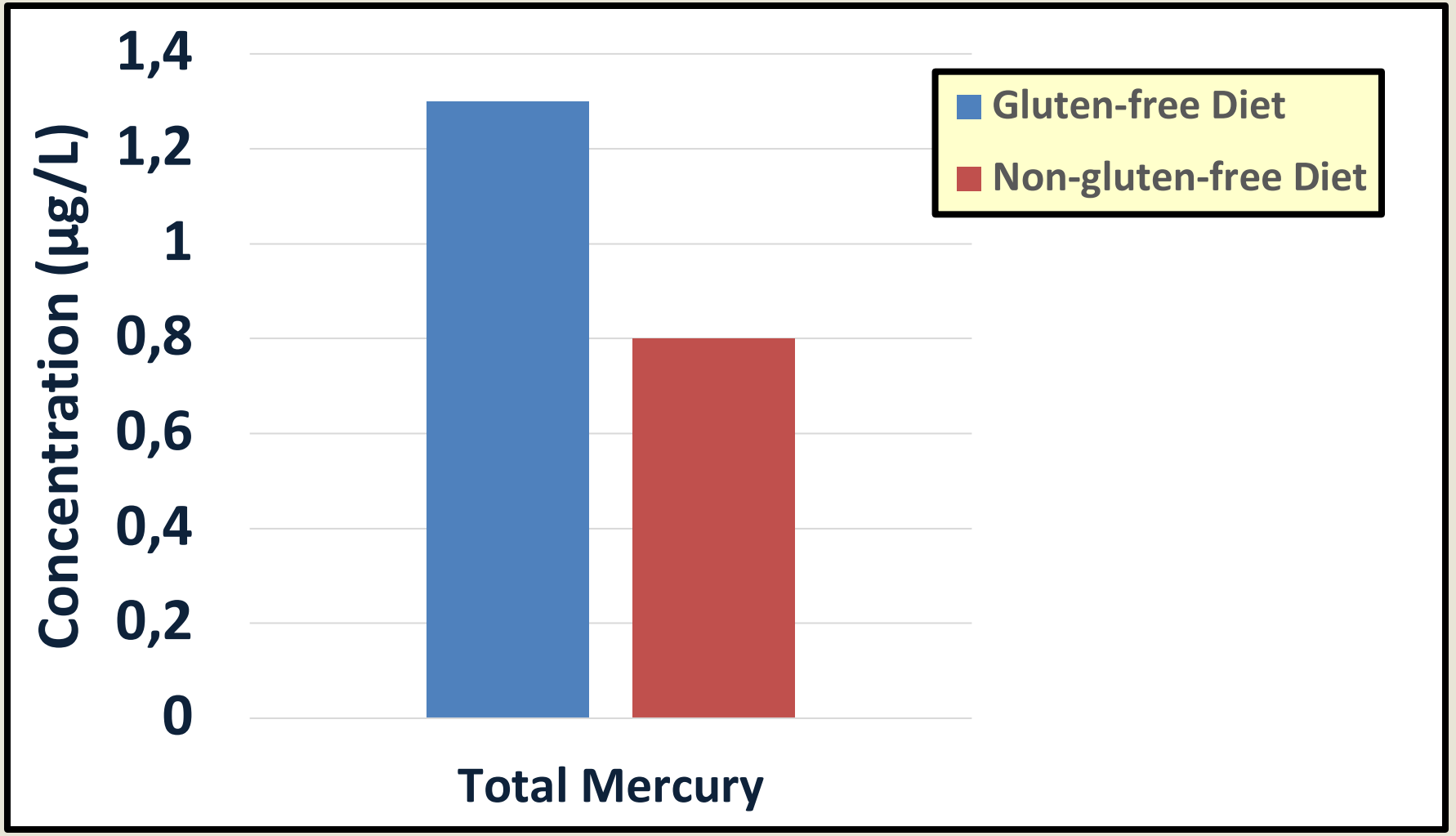
Despite such a dramatic shift in the diet of many Americans, little is known about how gluten-free diets might affect exposure to toxic metals found in certain foods.

Urinary Metal Concentrations by Gluten-free Diet Status



Bulka et al, *Epidemiol*, 2017;28:e24-e25

Blood Metal Concentrations by Gluten-free Diet Status

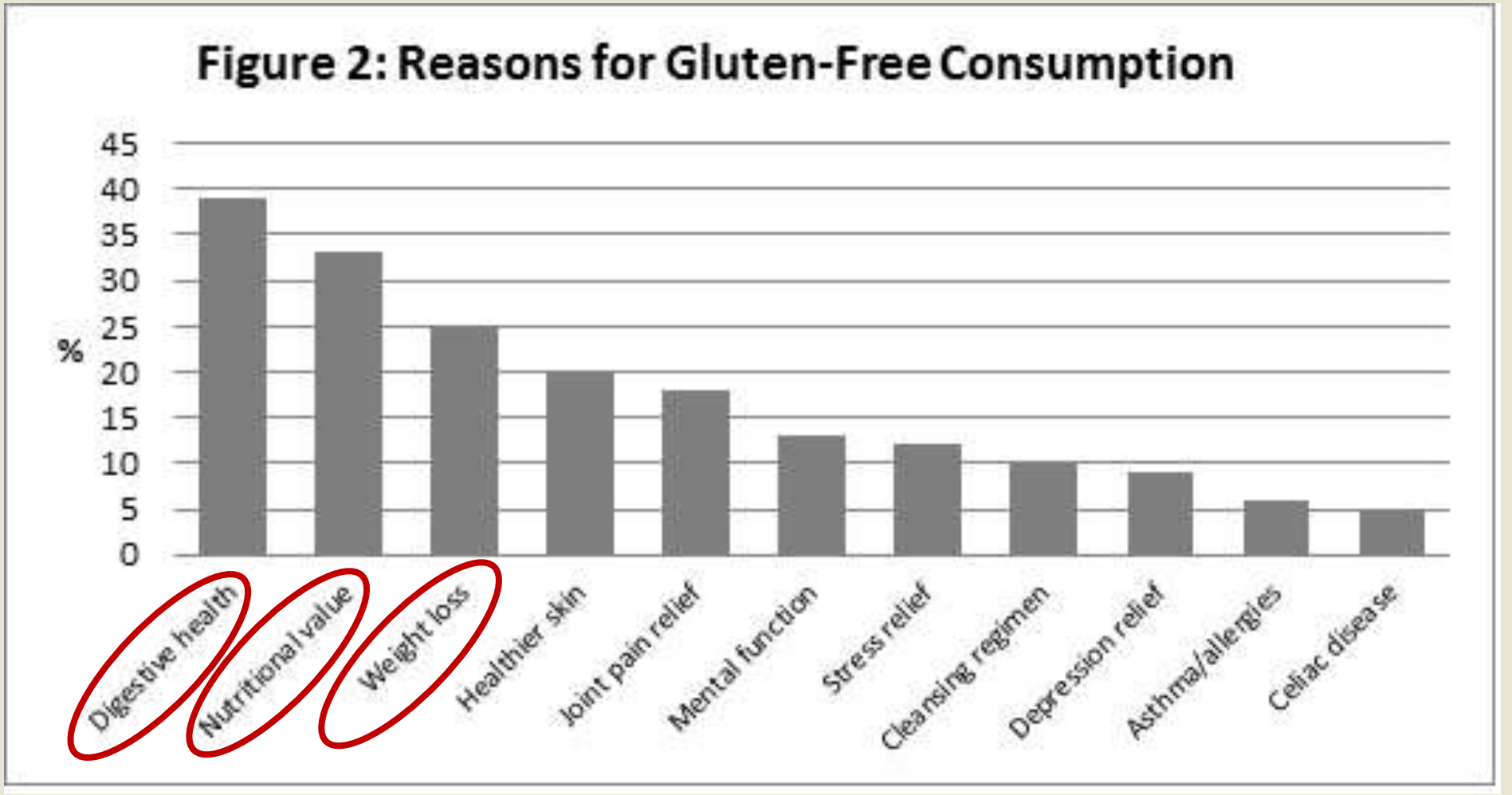


Bulka et al, *Epidemiol*, 2017;28:e24-e25

Conclusions

"Americans on gluten-free diets may be exposed to higher levels of arsenic and mercury. With the increasing popularity of gluten-free diets, these findings may have important health implications because the health effects of low-level arsenic and mercury exposure from food sources are uncertain but may increase the risk for cancer and other chronic diseases."

Bulka et al, *Epidemiol*, 2017;28:e24-e25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Cleansing regimen
Depression relief
Asthma/allergies
Celiac disease

Wheat and Gastrointestinal Health

- Oligifructose and inulin (naturally occurring fructan-type resistant starches) help create a healthy composition of gut bacteria
  - Protection against some cancers and inflammatory conditions
  - May help reduce risk of CVD
- Wheat contributes ~70-78% of oligofructose and inulin in typical North American diet

Presence of Inulin and Oligofructose in the Diets of Americans

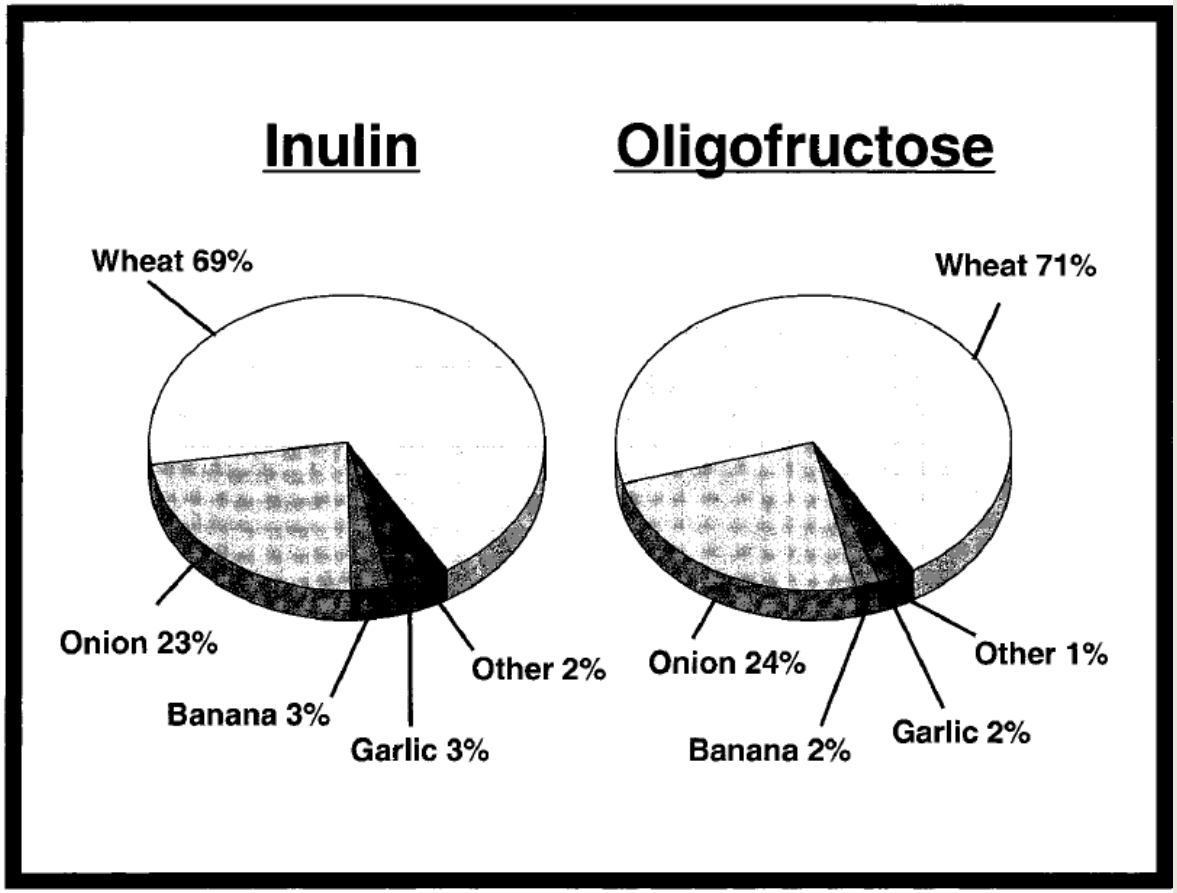


FIGURE 1 Contribution of food sources to inulin and oligofructose in American diets. Data presented in this figure are from the 1994–1996 Continuing Survey of Food Intakes by Individuals using the specialized database for inulin and oligofructose.

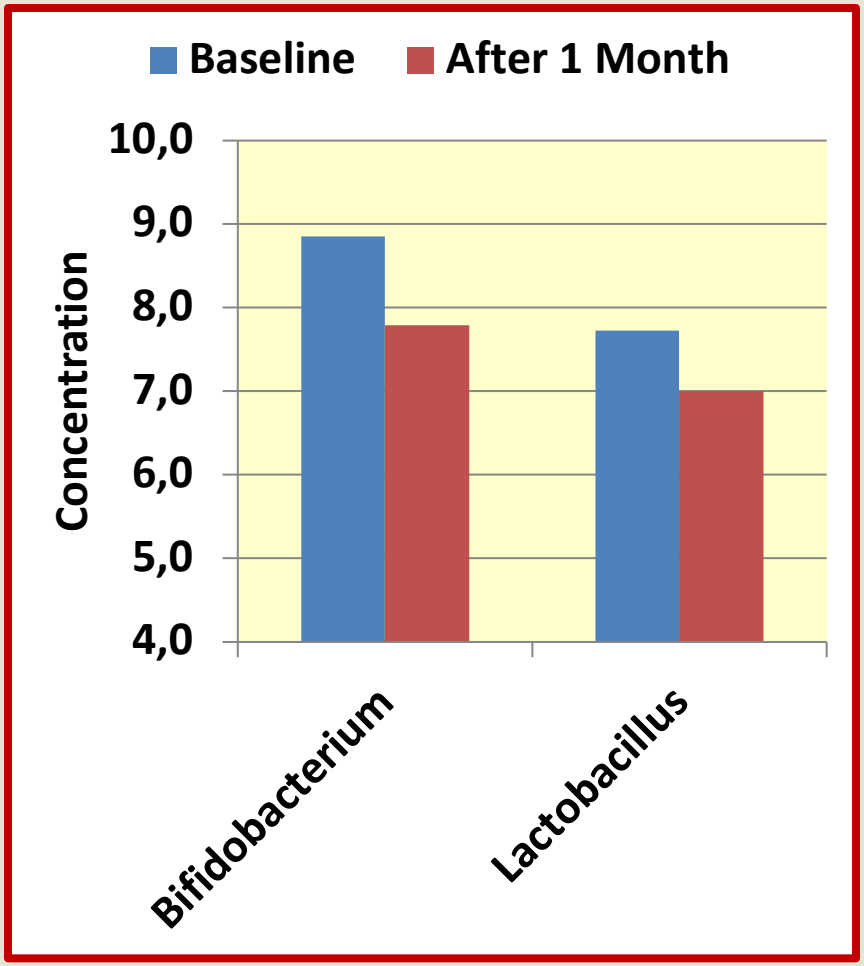
Moshfegh et al, *J Nutr*, 1999

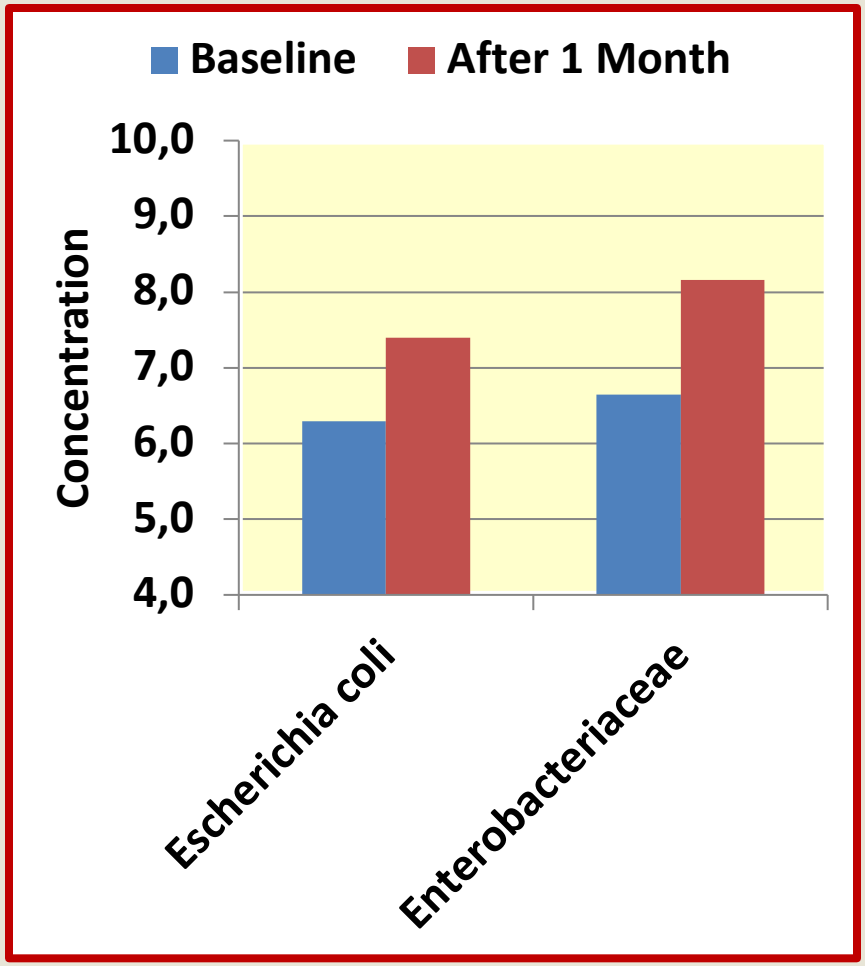
Effects of a Gluten-free Diet on Gut Microbiota in Healthy Adult Human Subjects

- 10 healthy adults (8 women)
- Gluten-free diet for 1 month
  - All gluten-containing foods replaced by certified gluten-free products
- Fecal samples collected and analyzed before and after
- Multiple analytic techniques

De Palma et al, *Brit J Nutr,* 2009

Effects of a Gluten-free Diet on Gut Microbiota and Healthy Adult Human Subjects





De Palma et al, *Brit J Nutr,* 2009

Removal of the major source (wheat) of fructan-type resistant starches may have adverse consequences

Nutritional Impact of Going Gluten-Free

- Diet can be high in fat, calories and meat
- Gluten-free products may be higher in calories
- Alternative grain foods may be higher in sugar and fat, and of lower diet quality
  - Rice cereal and/or rice-tapioca bread, muffins, chips, doughnuts, cookies
  - High glycemic and low in whole grains and fiber
  - Not enriched or fortified
  - Low in iron, niacin, riboflavin, thiamin, folate

Jenkins et al 1987 *AJCN* 45: 946-951; Berti 2004 *EJN* 43: 198-204

A Gluten-Free Diet is Essential for Those with Celiac Disease (~1%) or Gluten Sensitivity (~6%)

But…

Is Going "Gluten-Free" Sound Dietary Advice for the Other 93%?

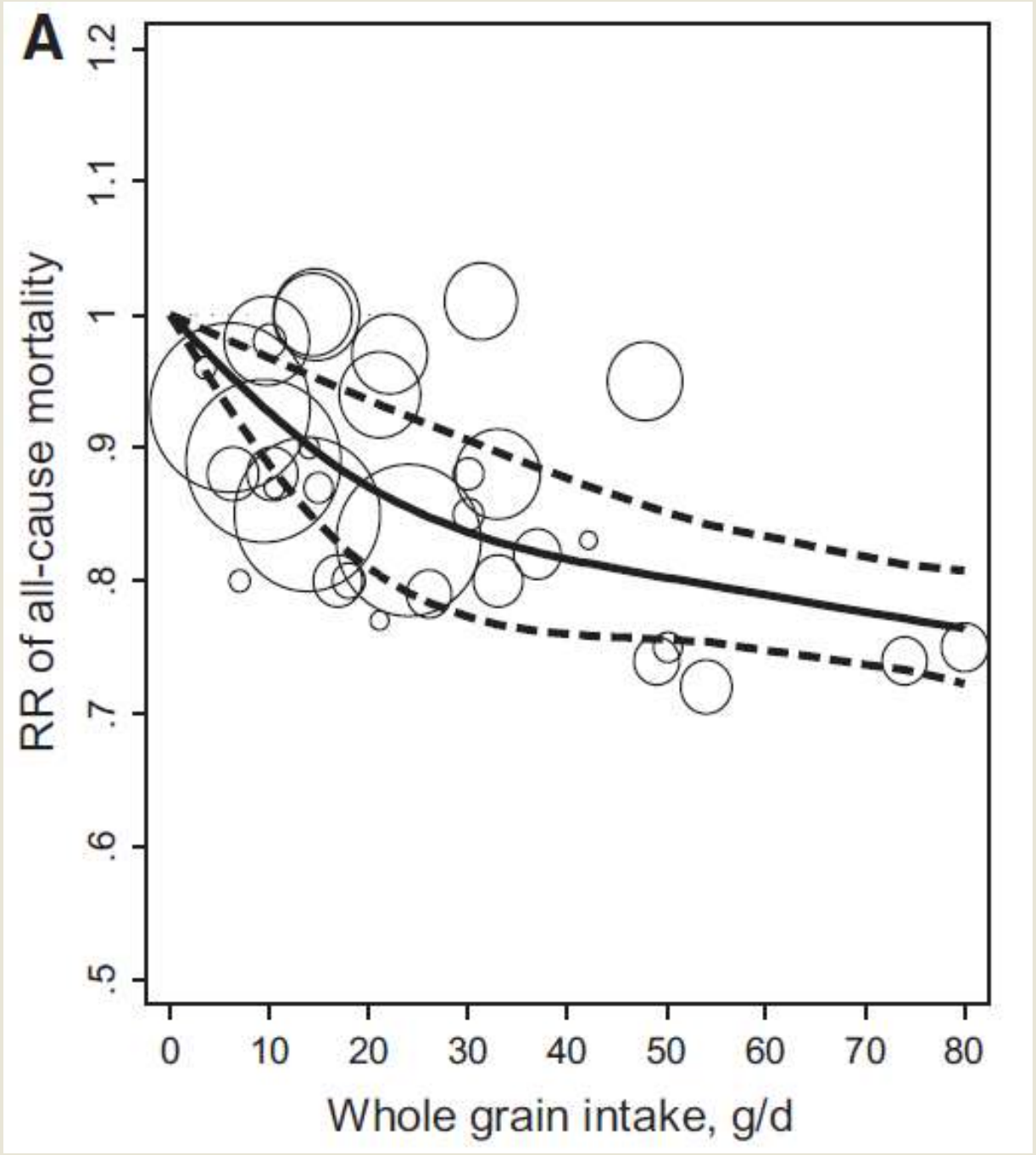
Overall Conclusions

- There is no evidence to suggest that following a gluten-free diet has any significant benefits in the general population
- A gluten-free diet may adverse consequences for gastrointestinal health
- Avoidance of gluten may decrease whole-grain and cereal fiber intake, and this may affect cardiovascular disease risk

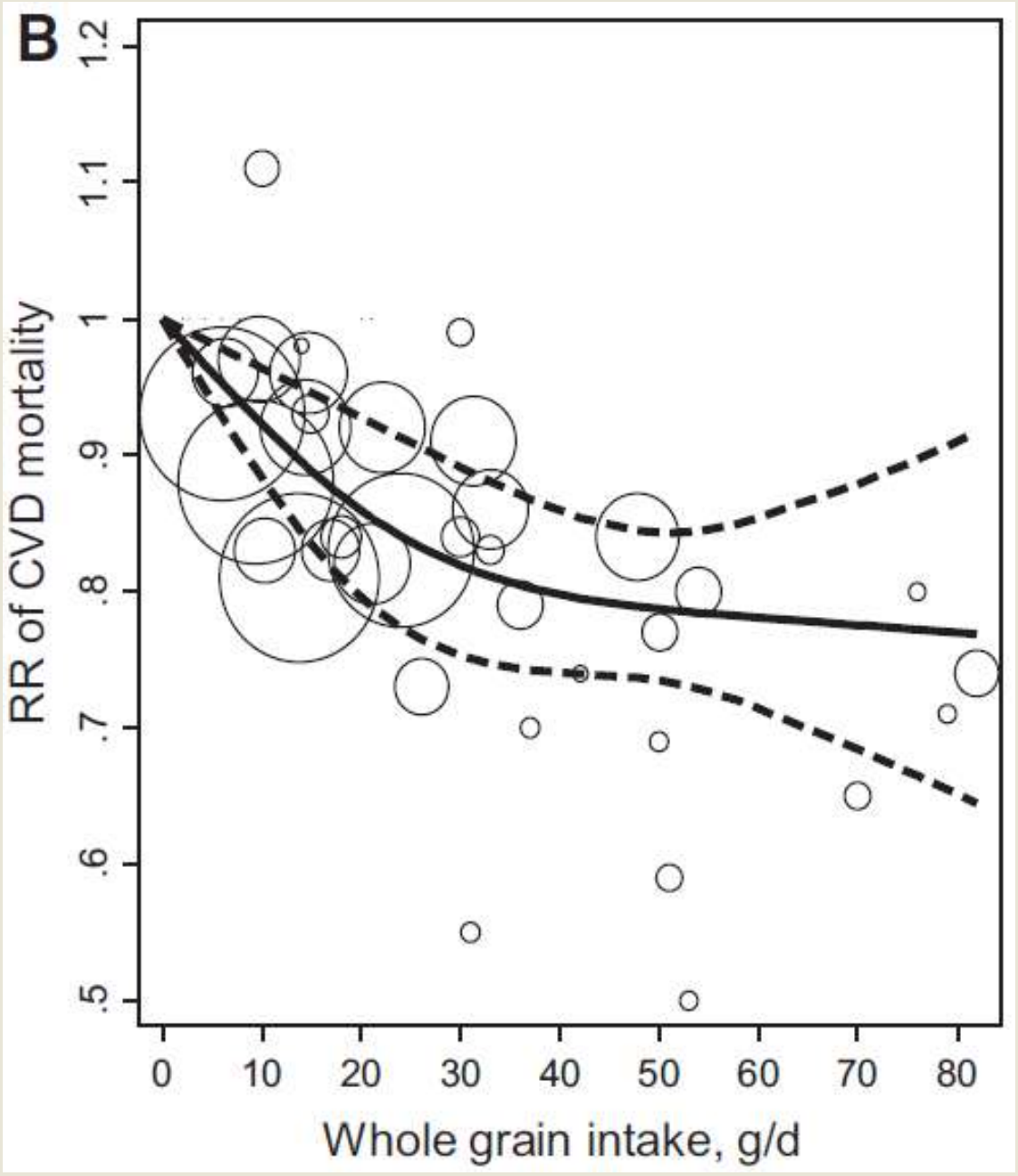
Major Meta-analyses Published in 2016 show that Whole-grain Consumption is Associated with Reduced Risk of All-Cause and Cause-specific Mortality

- Aune et al, *BMJ* 2016; 353:i2716
- Chen et al, *Am J Clin Nutr* 2016; 104:164-172
- Zong et al, *Circulation* 2016;133:2370-2380

Whole Grain Intake and All-Cause Mortality

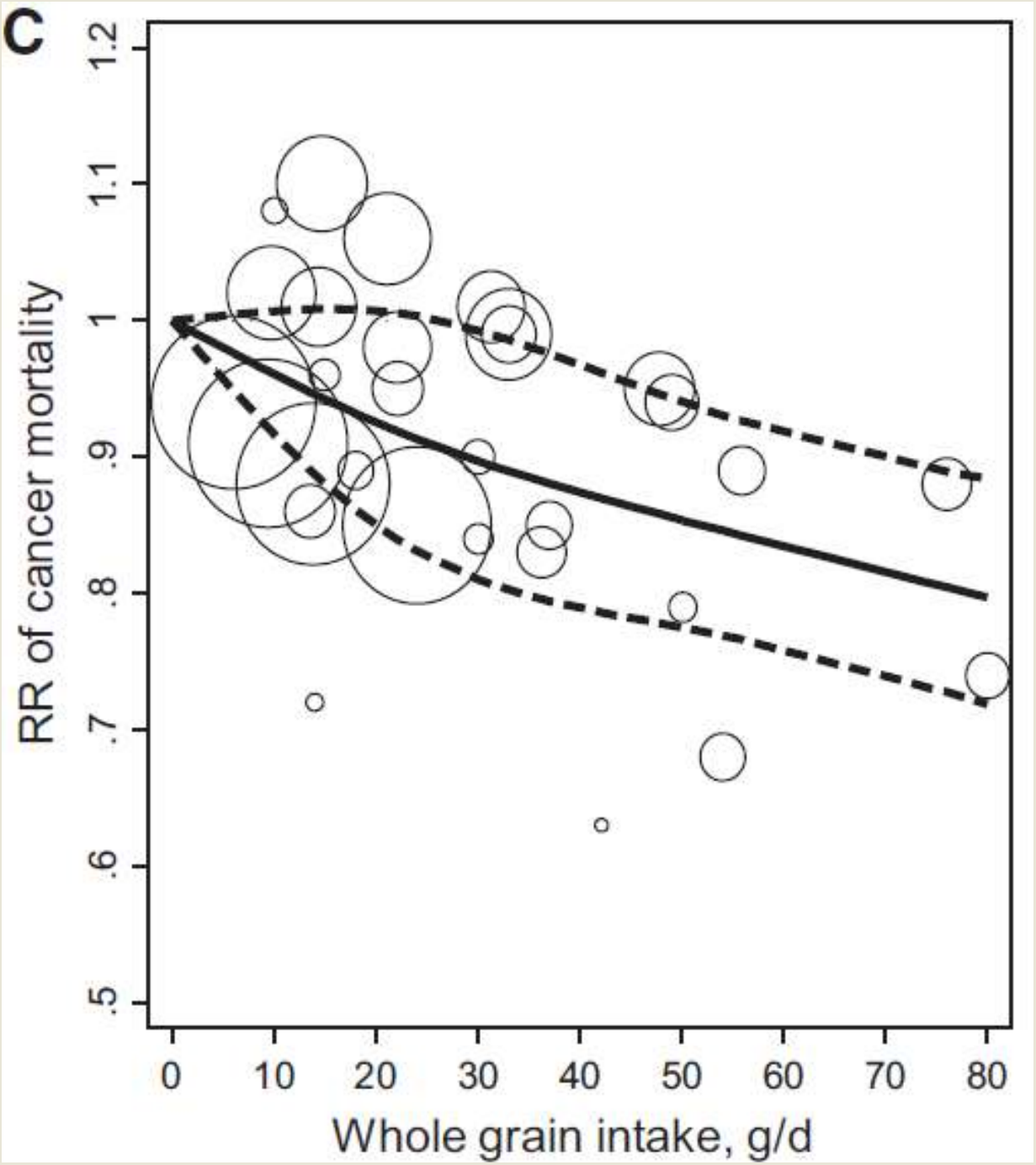


Zong et al, *Circulation* 2016;133:2370-2380



Whole Grain Intake and CVD Mortality

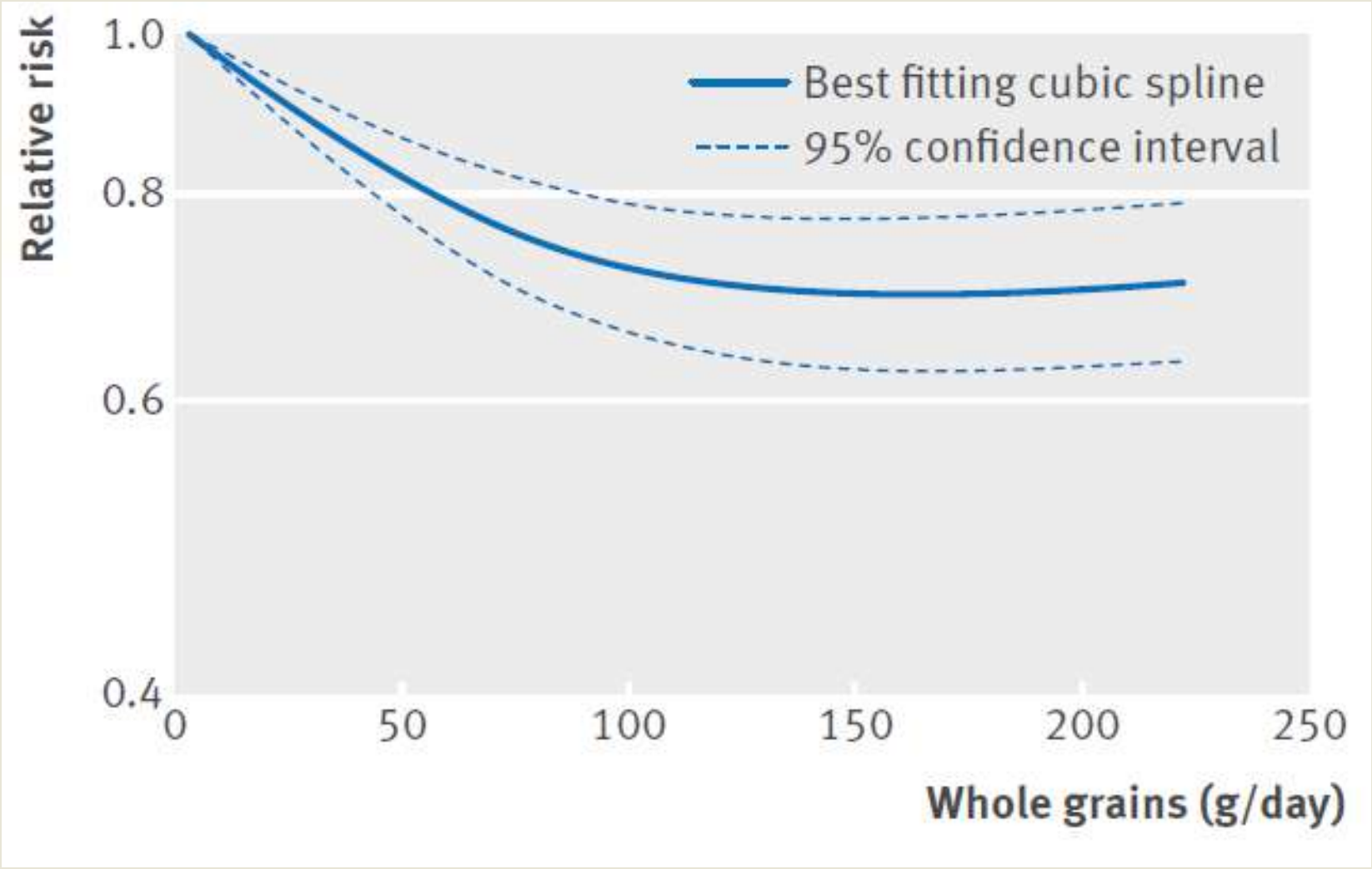
Zong et al, *Circulation* 2016;133:2370-2380



Whole Grain Intake and Cancer Mortality

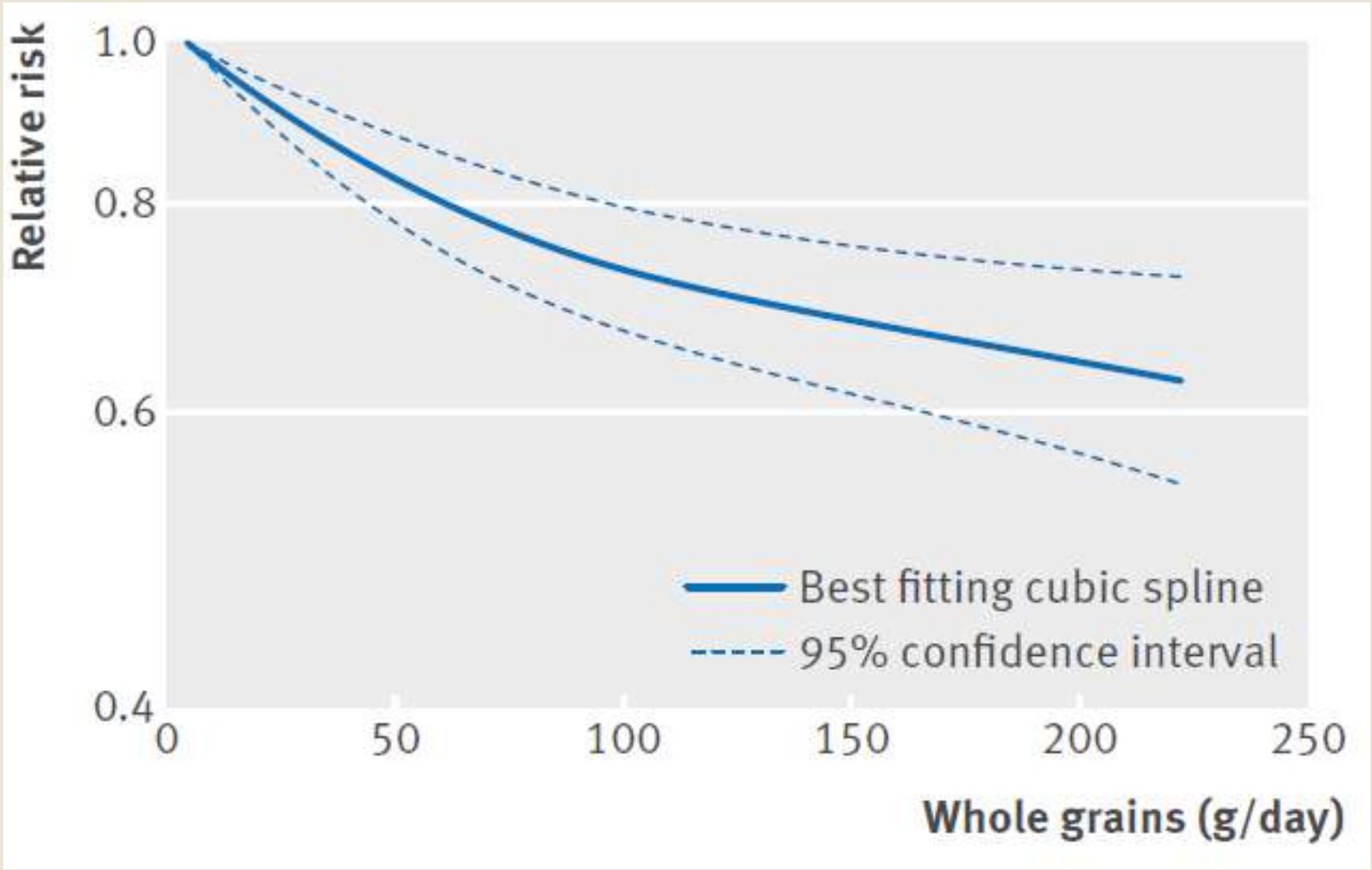
Zong et al, *Circulation* 2016;133:2370-2380

Whole Grain Intake and Stroke Mortality



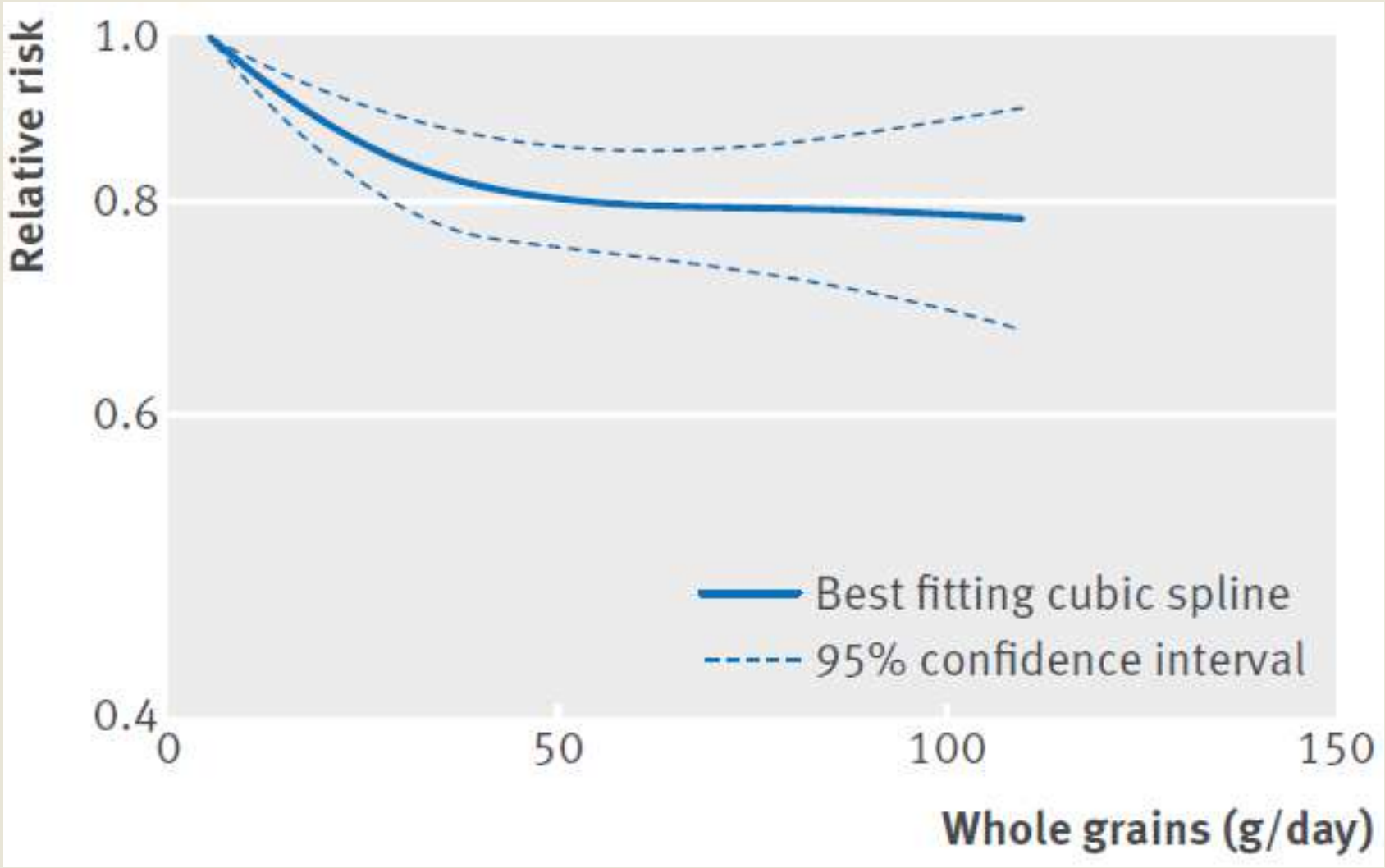
Aune et al, *BMJ* 2016; 353:i2716

Whole Grain Intake and Respiratory Disease Mortality



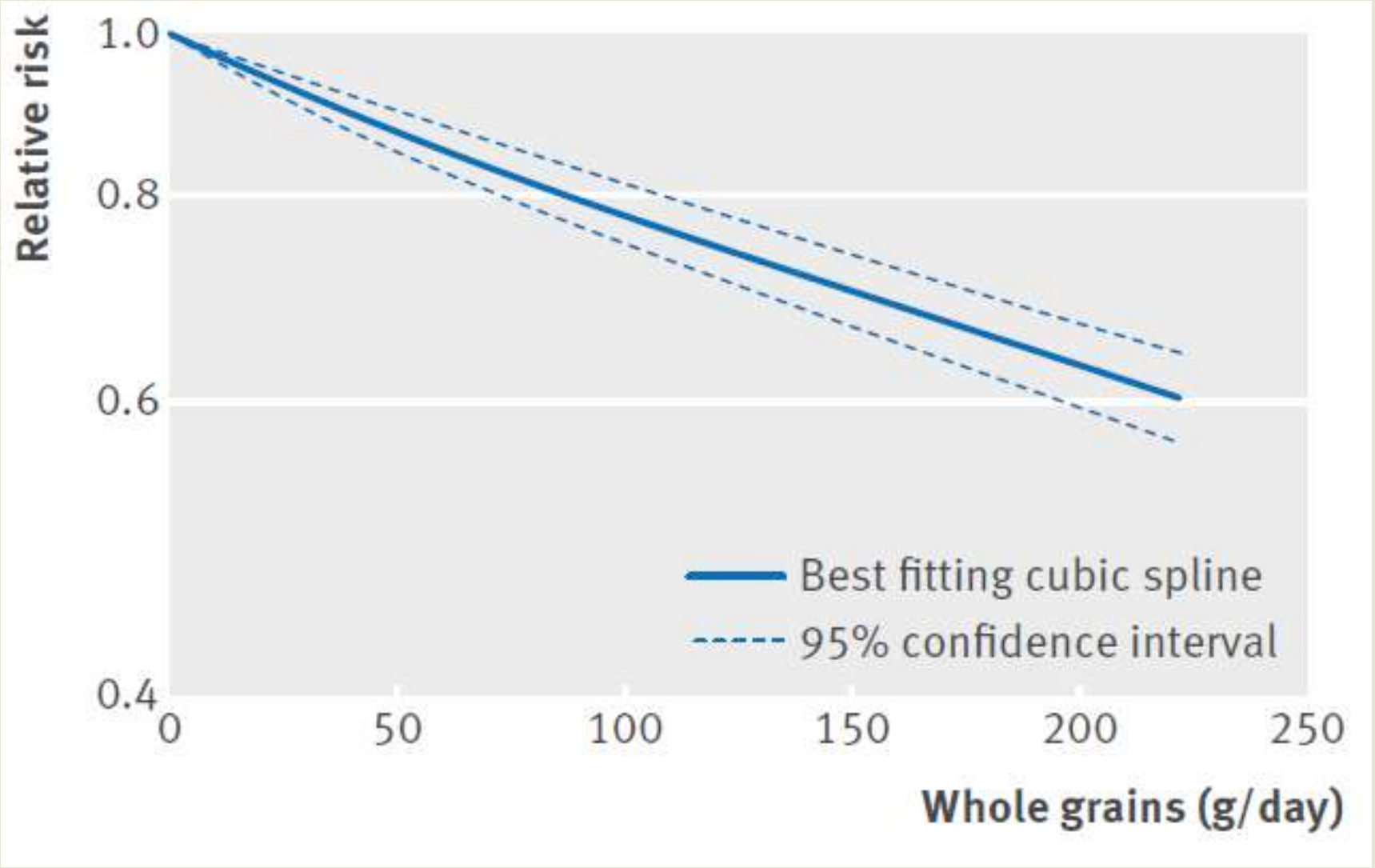
Aune et al, *BMJ* 2016; 353:i2716

Whole Grain Intake and Mortality from Infectious Disease



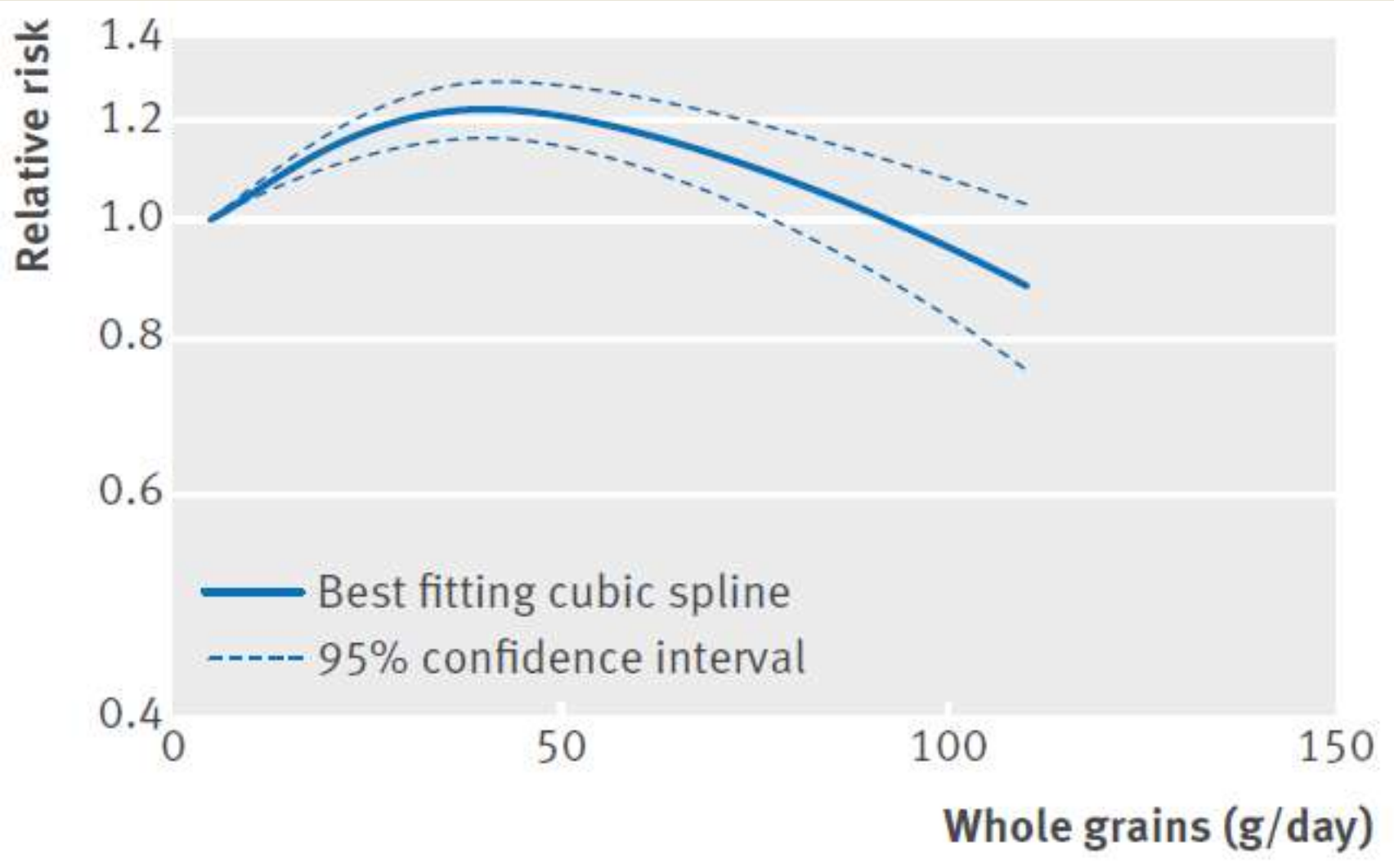
Aune et al, *BMJ* 2016; 353:i2716

Whole Grain Intake and Mortality from Non-cardiovascular, Non-cancer Causes



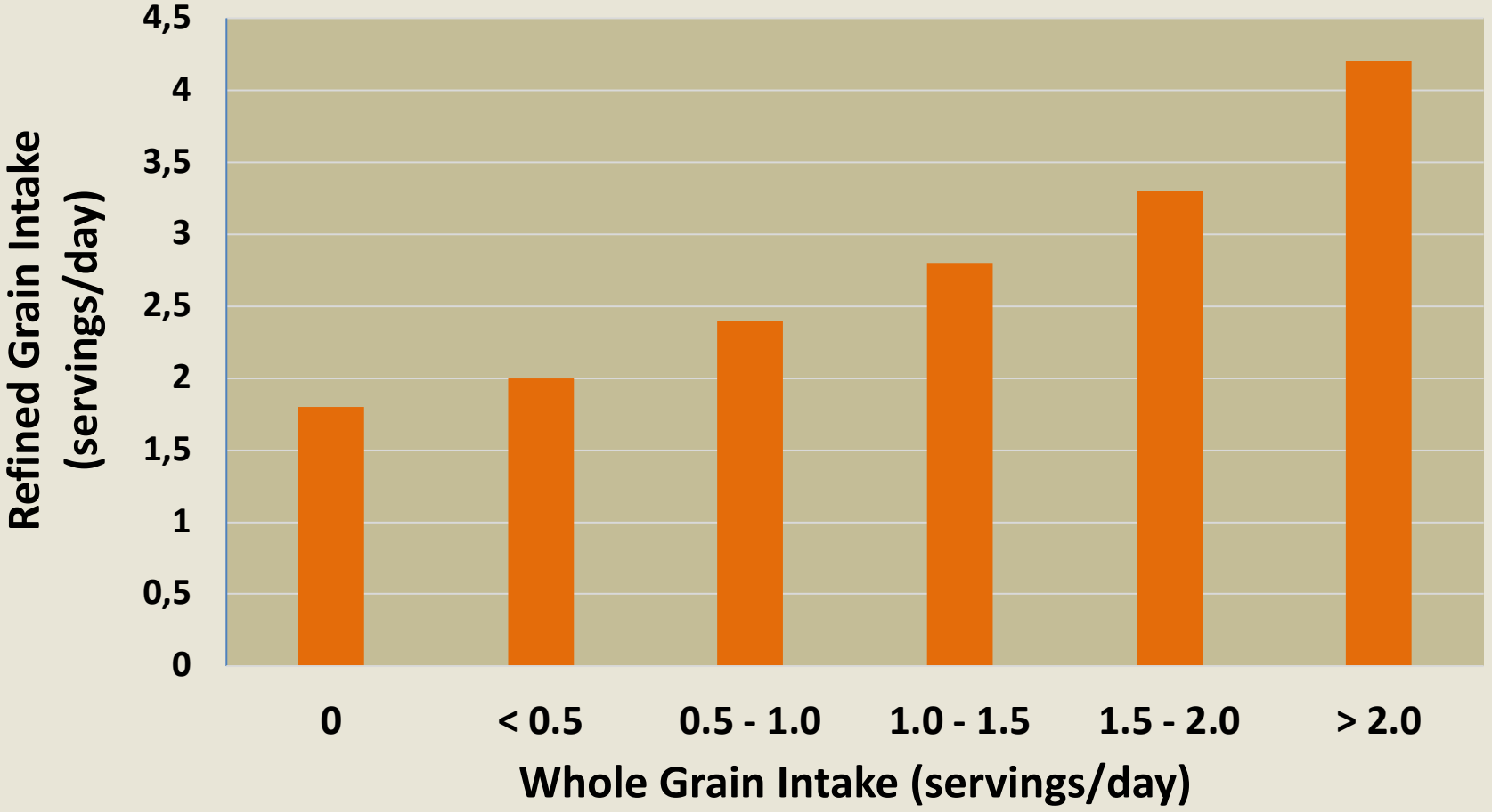
Aune et al, *BMJ* 2016; 353:i2716

Whole Grain Intake and Risk of Mortality of Diseases of the Nervous System



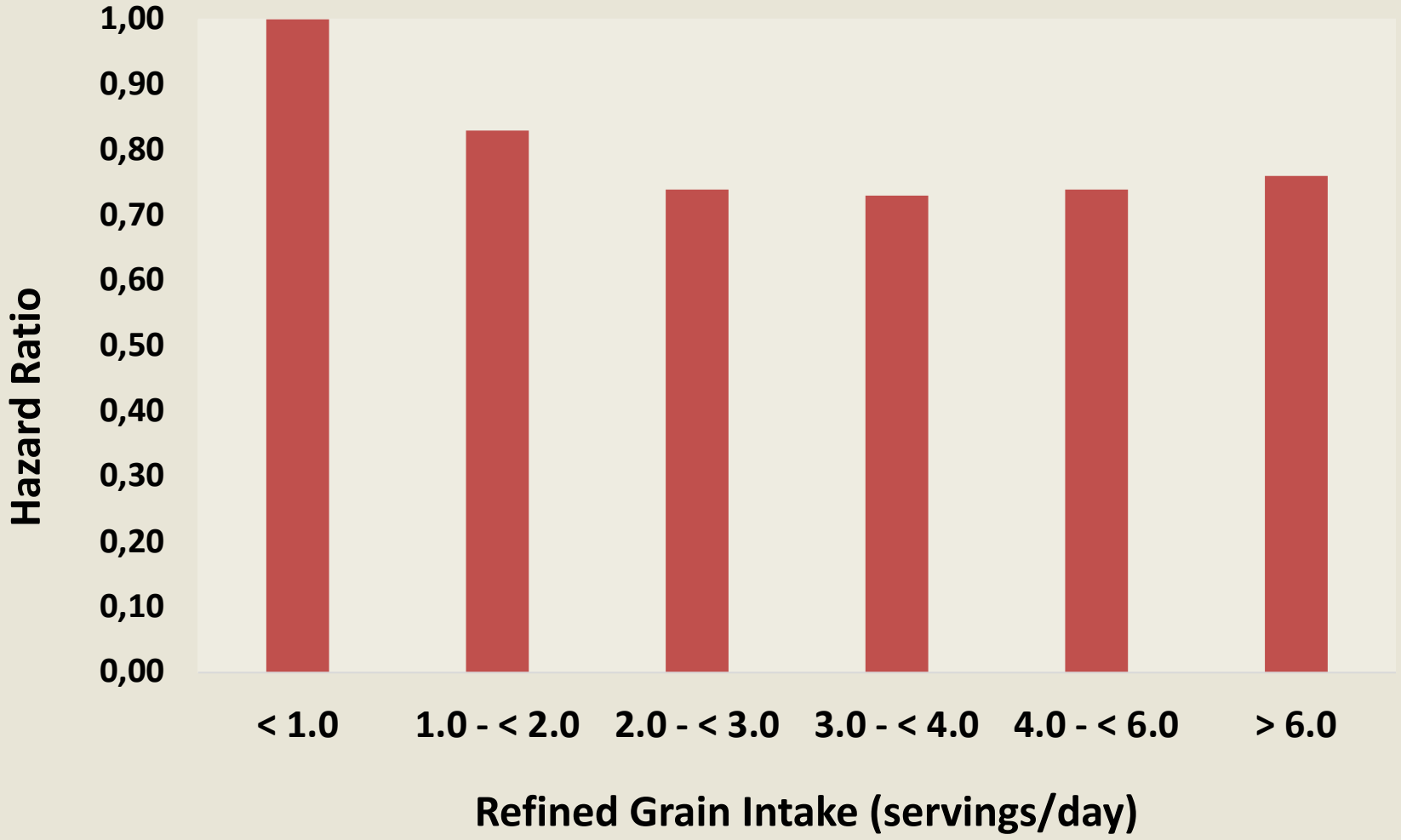
Aune et al, *BMJ* 2016; 353:i2716

Refined grain intake by category of whole grain consumption at baseline: Women's Health Initiative Observational Study, 1993-1998



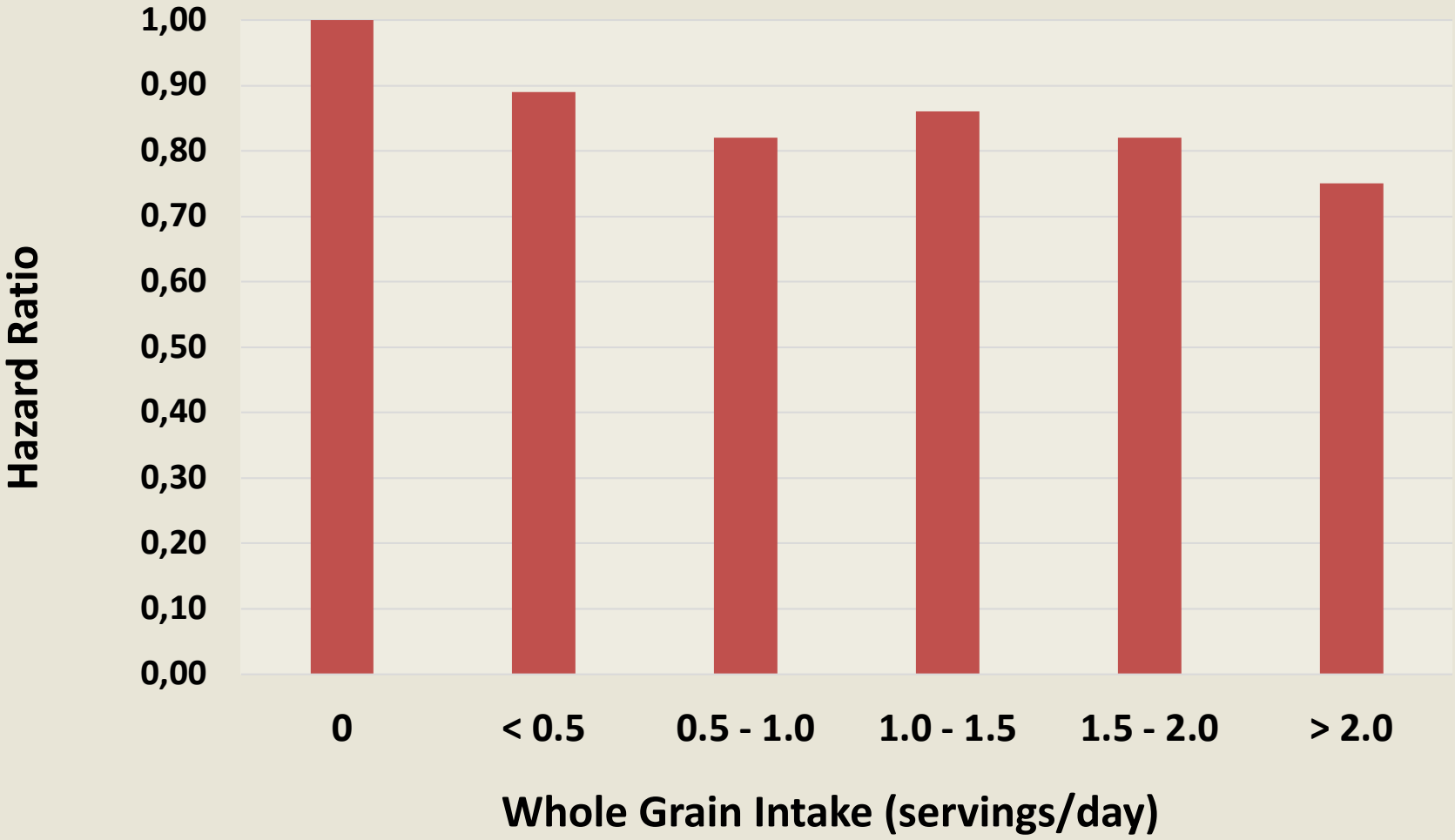
Parker et al, *Ann Epidemiol* 2013; 23:321-327

Hazard ratios for type 2 diabetes by refined grain intake: Women's Health Initiative Observational Study, 1993 - 2005



Parker et al, *Ann Epidemiol* 2013; 23:321-327

Hazard ratios for type 2 diabetes by whole grain intake: Women's Health Initiative Observational Study, 1993 - 2005



Parker et al, *Ann Epidemiol* 2013; 23:321-327

Conclusions

- Women who consumed the most whole grains also had the highest consumption of refined grains
- This pattern of high grain consumption, from both whole and refined sources, was associated with the lowest risk of incident type 2 diabetes

Parker et al, *Ann Epidemiol* 2013; 23:321-327

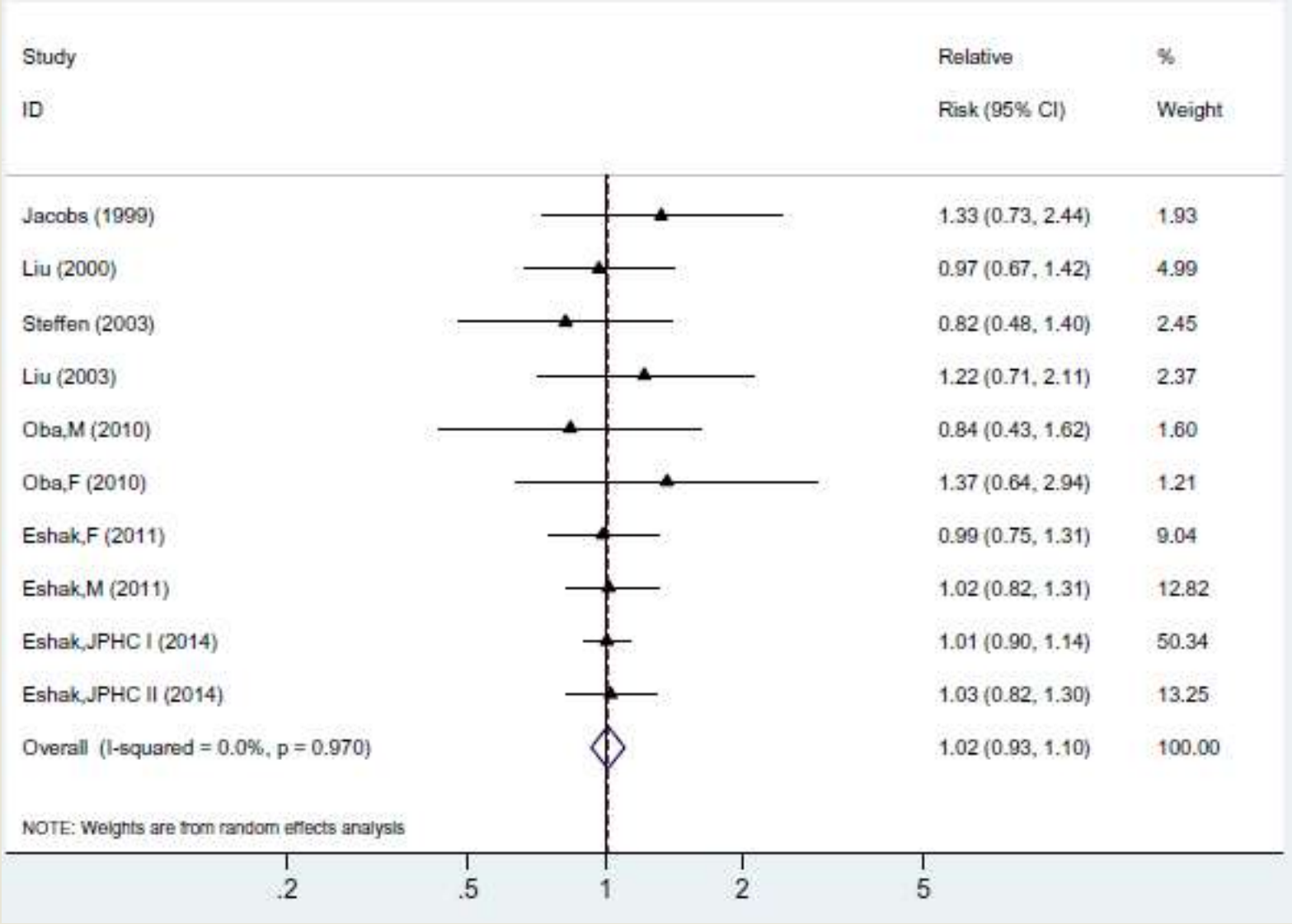
No Evidence of Increased Risk of Stroke with Consumption of Refined Grains: A Meta-analysis of Prospective Cohort Studies

Demo Wu, MD, Yixiang Guan, MD, Shujun Lv, MD, Haibo Wang, MD, and Jun Li, MD

- **Eight prospective studies**
- **410,810 adults (8,284 stroke events)**
- **5.5 – 15.2 years of follow-up; median = 11.0 years**

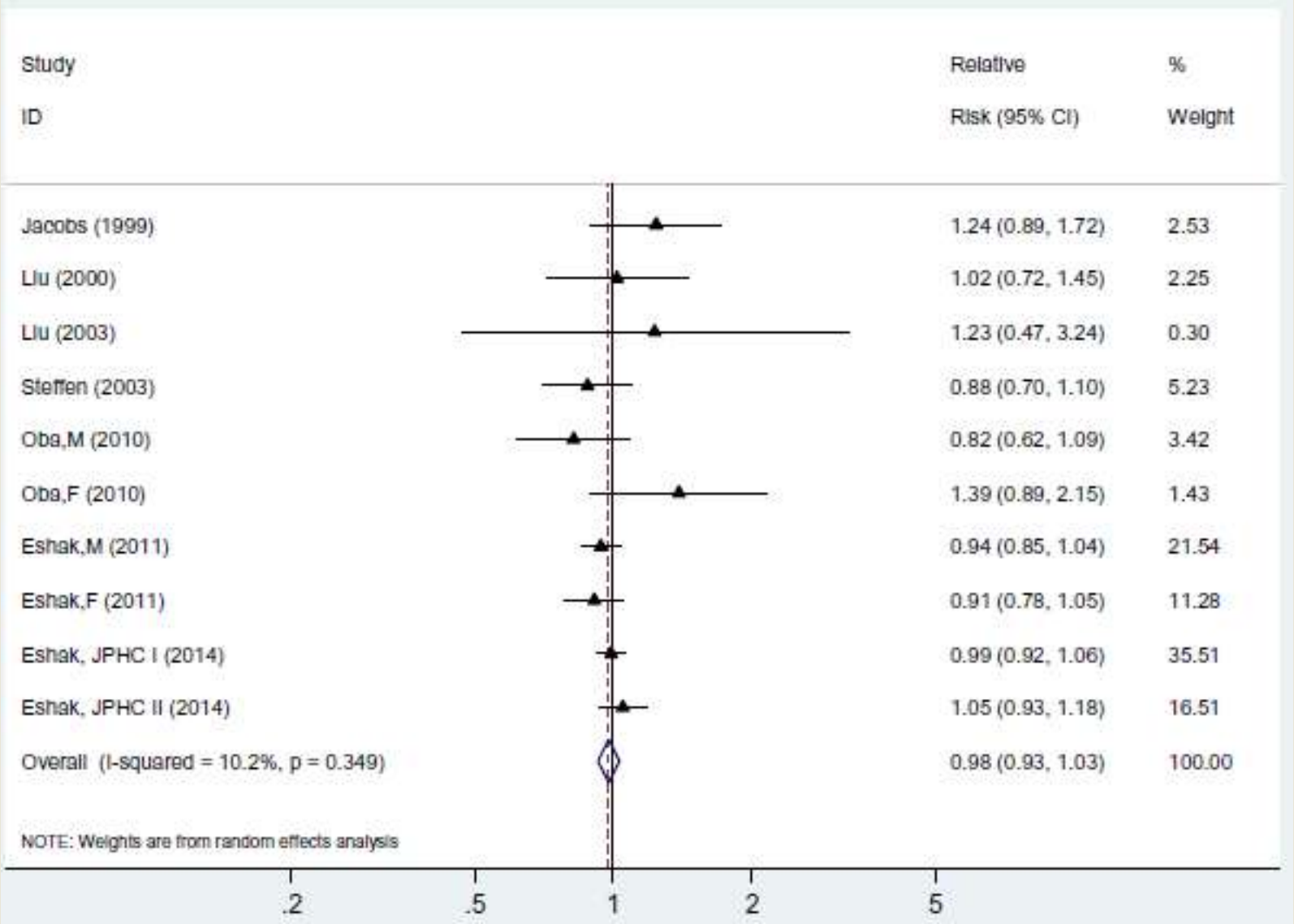
Wu et al, *J Stroke Cerebrovasc Dis*, 2015;24:2738-2746

Stroke Risk
Low vs. High Intake of Refined Grains



Wu et al, *J Stroke Cerebrovasc Dis*, 2015;24:2738-2746

Stroke Risk
Linear analysis, per 3 servings/day increase



Wu et al, *J Stroke Cerebrovasc Dis*, 2015;24:2738-2746

Conclusion

Higher intake of refined grains is not associated with the risk of stroke in both men and women

Wu et al, *J Stroke Cerebrovasc Dis*, 2015;24:2738-2746