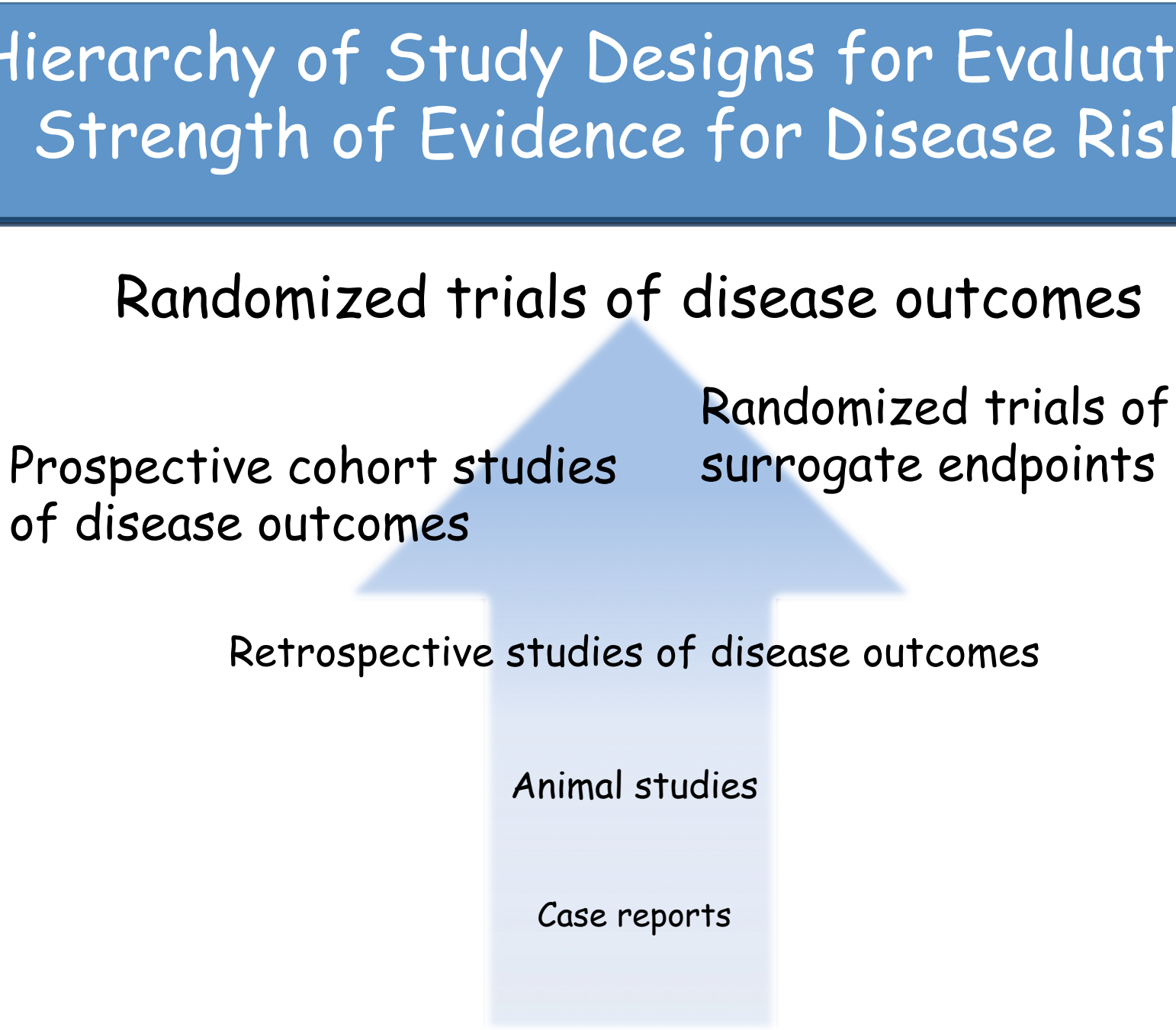
Whole Grains And Health: The Latest Research

Paul F Jacques, ScD
Nutritional Epidemiology Program

Tufts University
Jean Mayer
United States Department of Agriculture
Human Nutrition Research Center on Aging

Hierarchy of Study Designs for Evaluating Strength of Evidence for Disease Risk

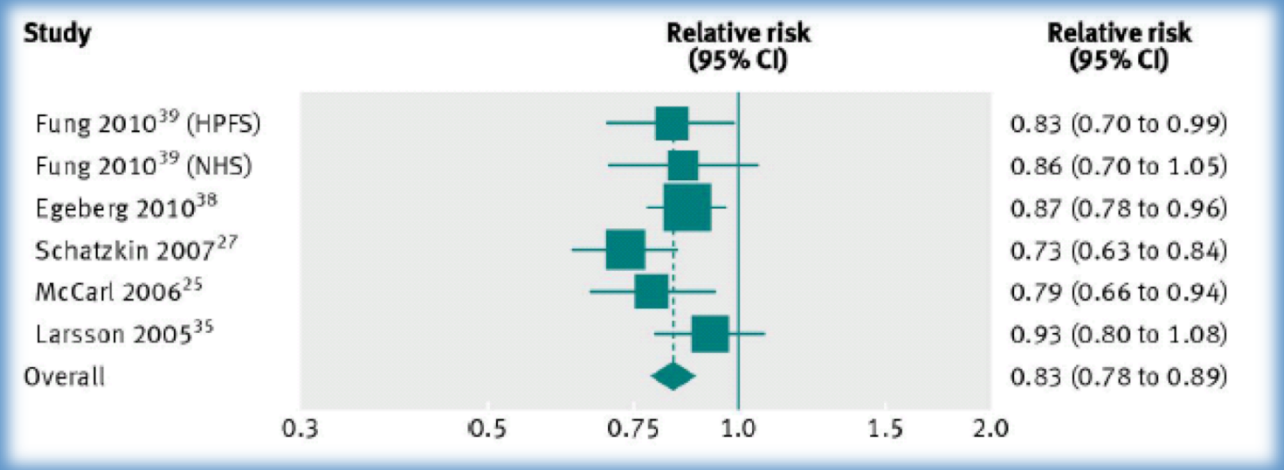


Prospective human evidence relating whole grains to disease risk

- Prospective cohort studies of disease outcomes
- Randomized trials of surrogate endpoints
- Randomized trials of disease outcomes

Whole grain intake and relative risk of colorectal cancer: a systematic review of prospective studies

Aune et al BMJ. 2011



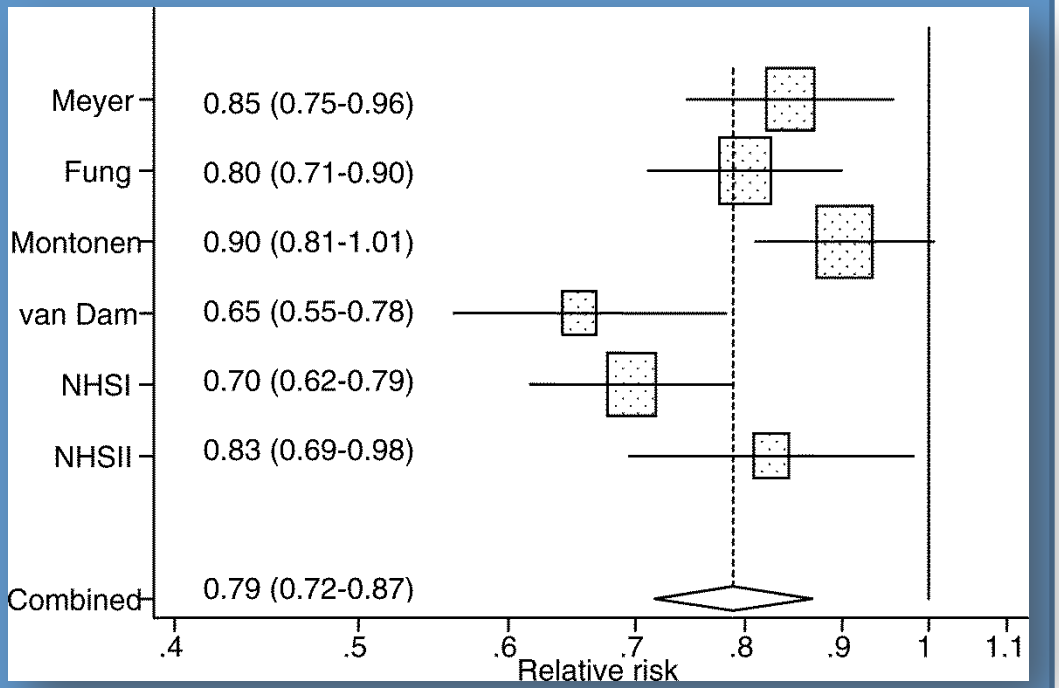
Multivariate-adjusted relative risk of colorectal cancer in high vs low whole grain intake categories. Bars (and diamond) indicate 95% confidence interval. The size of the squares corresponds to the weight of the study in the meta-analysis.

Whole grain and type 2 diabetes incidence – meta-analysis

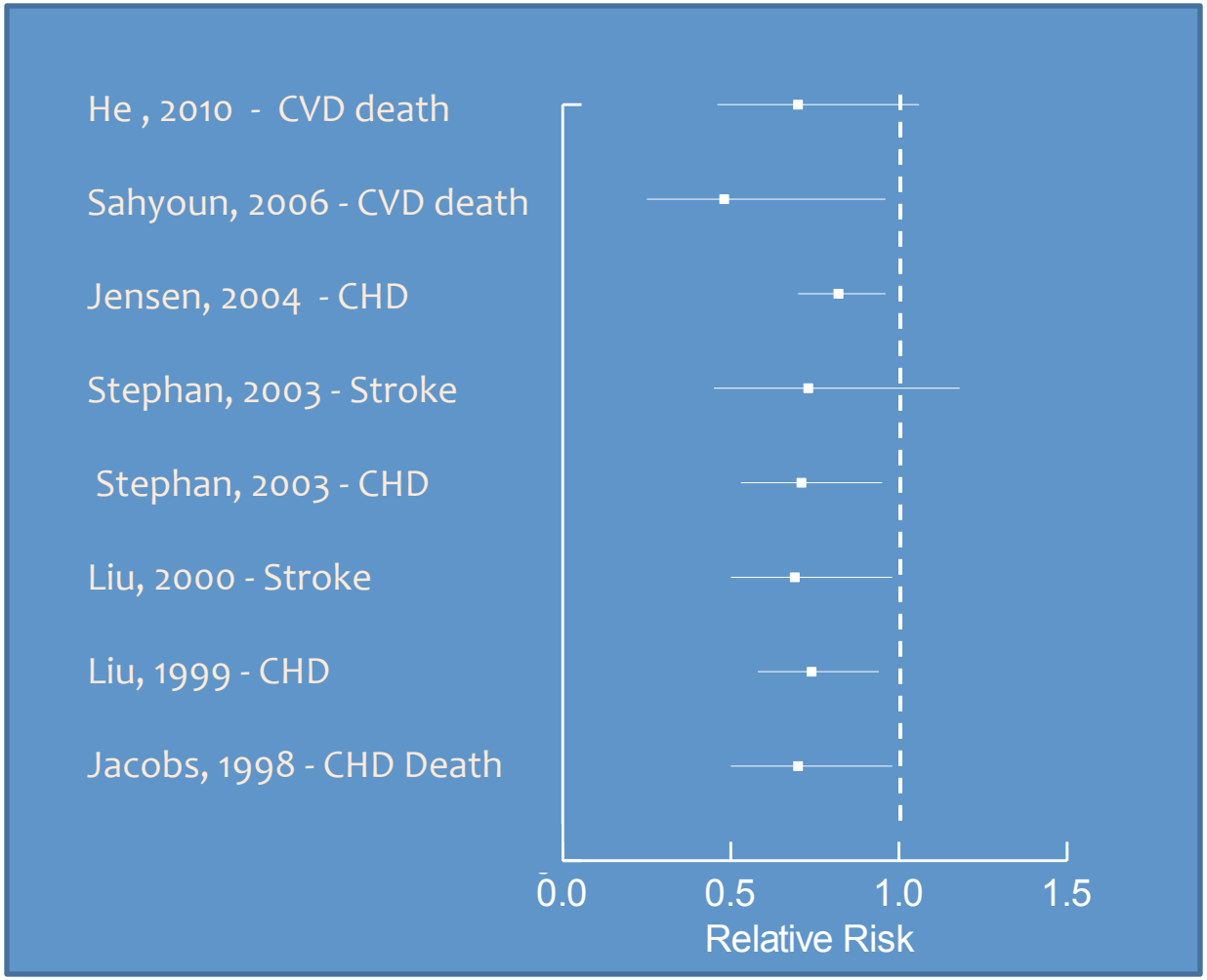
de Munter et al. PLOS Medicine 2007;4:1385

Multivariate-adjusted relative risk of type 2 diabetes for a two serv/d increment in whole grain intake.

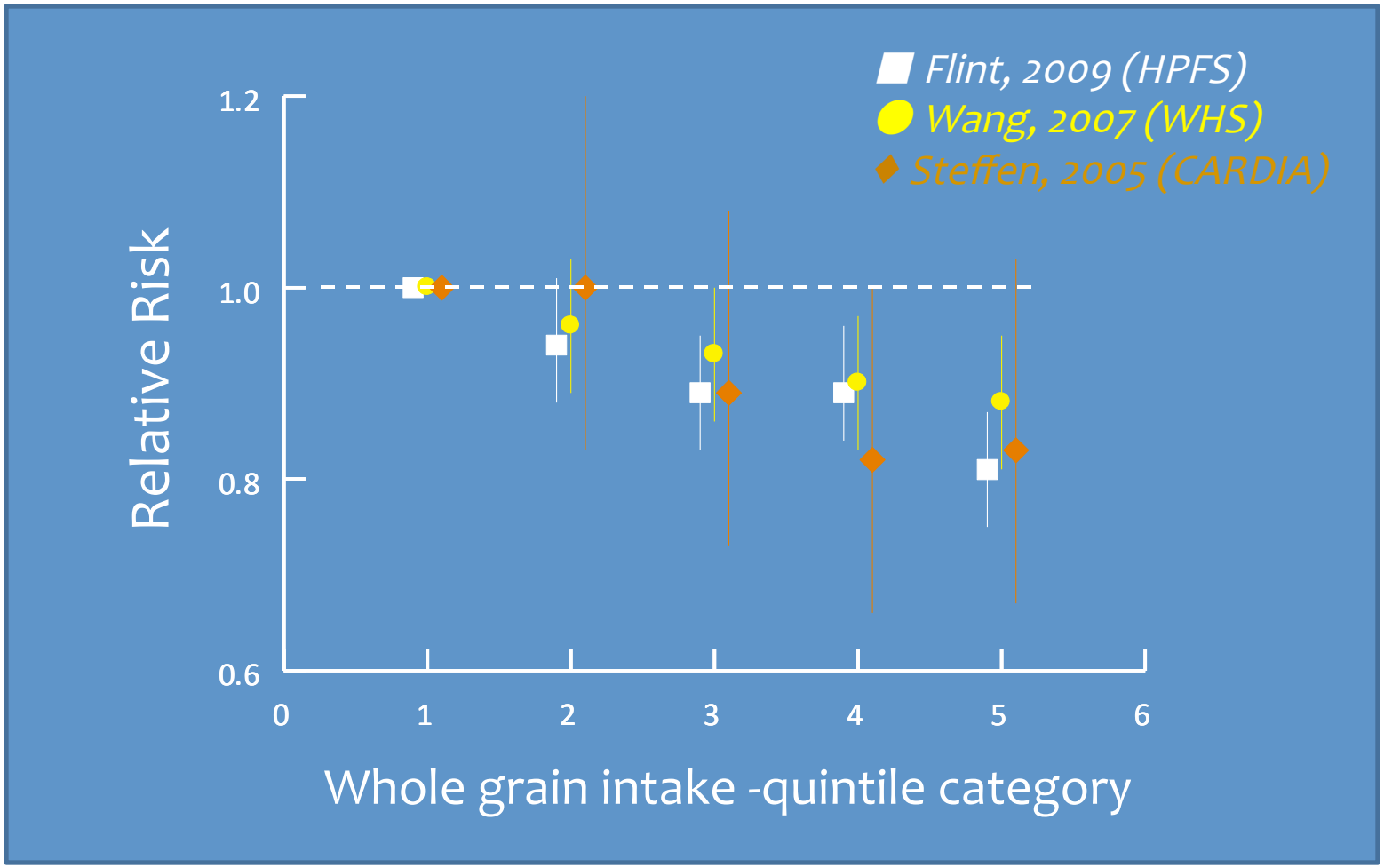
Bars (and diamond) indicate 95% confidence interval. The size of the squares corresponds to the weight of the study in the meta-analysis.



Prospective studies of whole grain intake and incident CVD

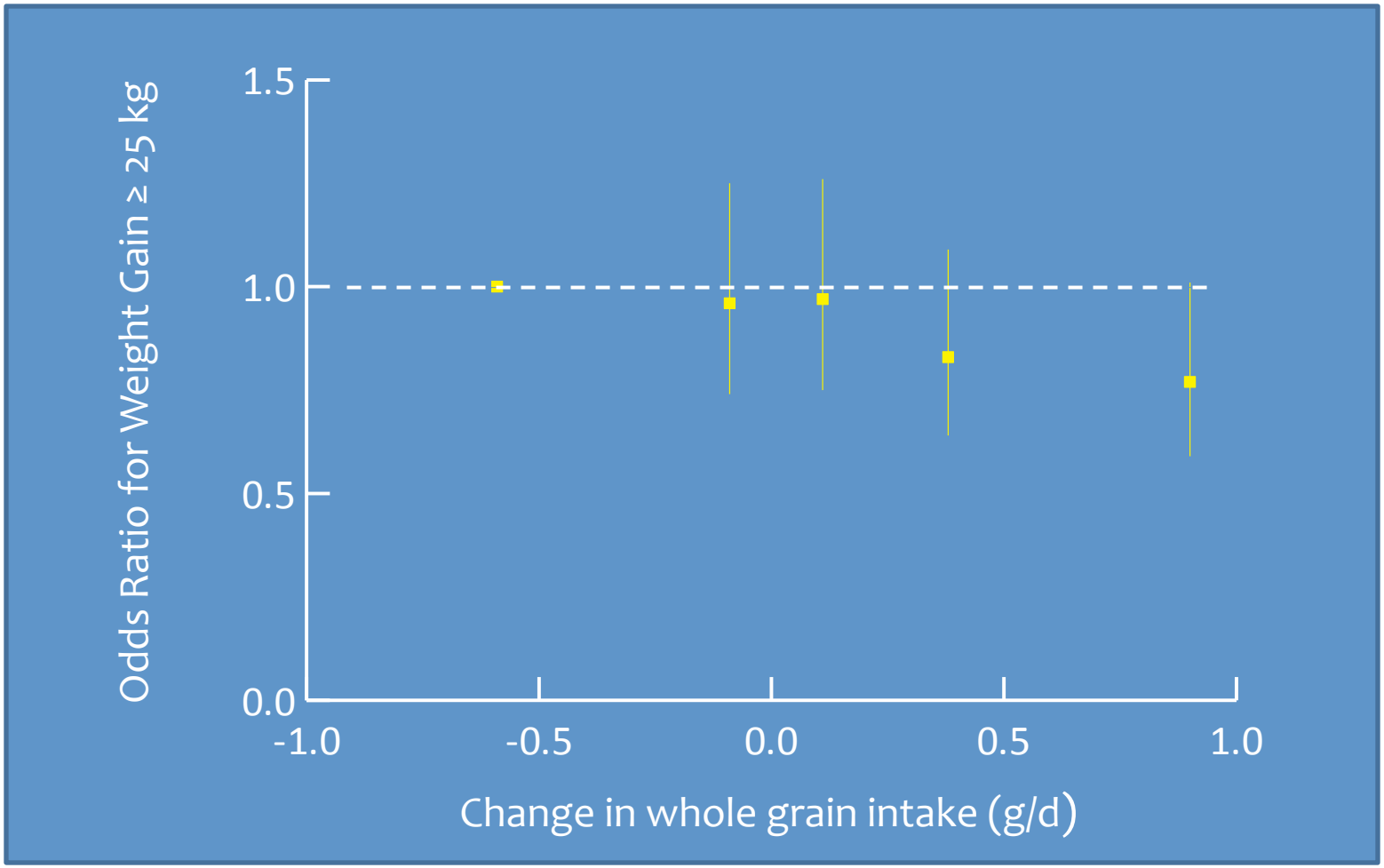


Whole grain intake and incidence of elevated blood pressure



Whole grain intake and development of obesity

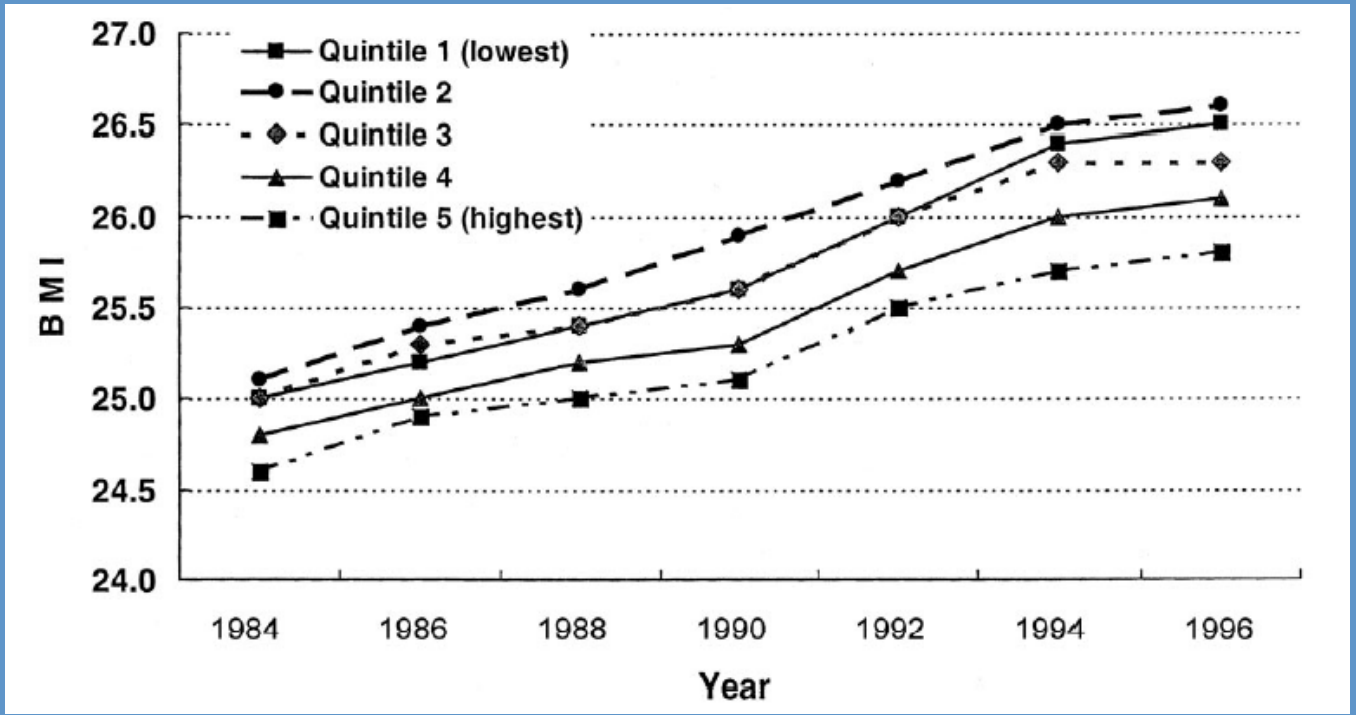
Adapted from Liu et al. AJCN 2003



Whole grain intake and Change in BMI

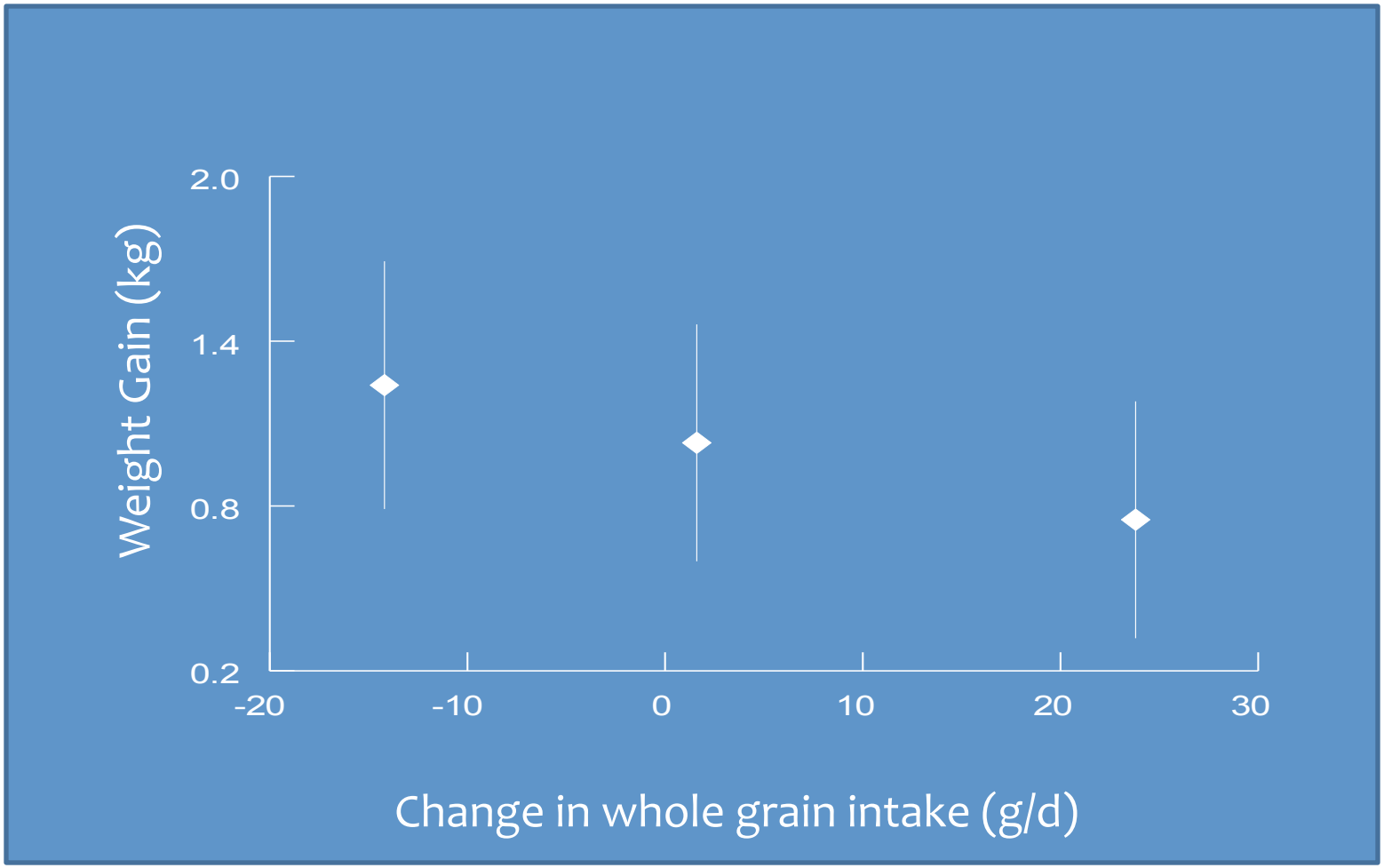
Adapted from Liu et al. AJCN 2003

Mean BMI from 1984 to 1996 according to quintiles of whole-grain intake



Whole grain intake and 8 year weight change

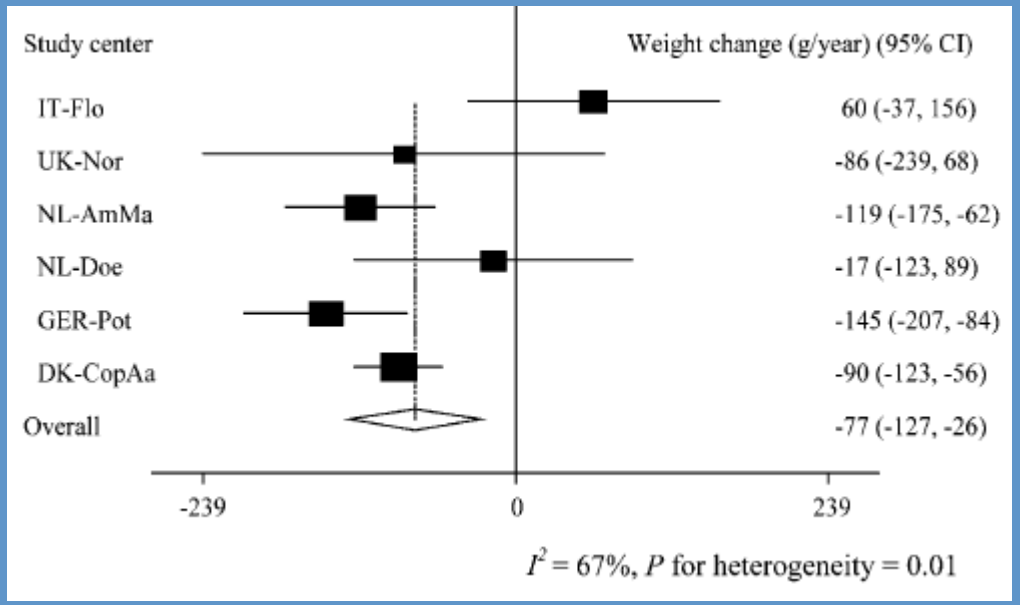
Adapted from Koh-Banerjee et al. AJCN 2004;80:1237



Cereal fiber intake and weight gain
Du et al. AJCN 2010;91:329

Prospective cohort study of 89,432 Europeans (EPIC) who were free of cancer, CVD, and diabetes followed for an average of 6.5 y.

The values presented are regression coefficients for a 10-g/d cereal fiber intake. Bars (and diamond) indicate 95% confidence interval. The size of the squares corresponds to the weight of the study in the meta-analysis.



Prospective human evidence relating whole grains to disease risk

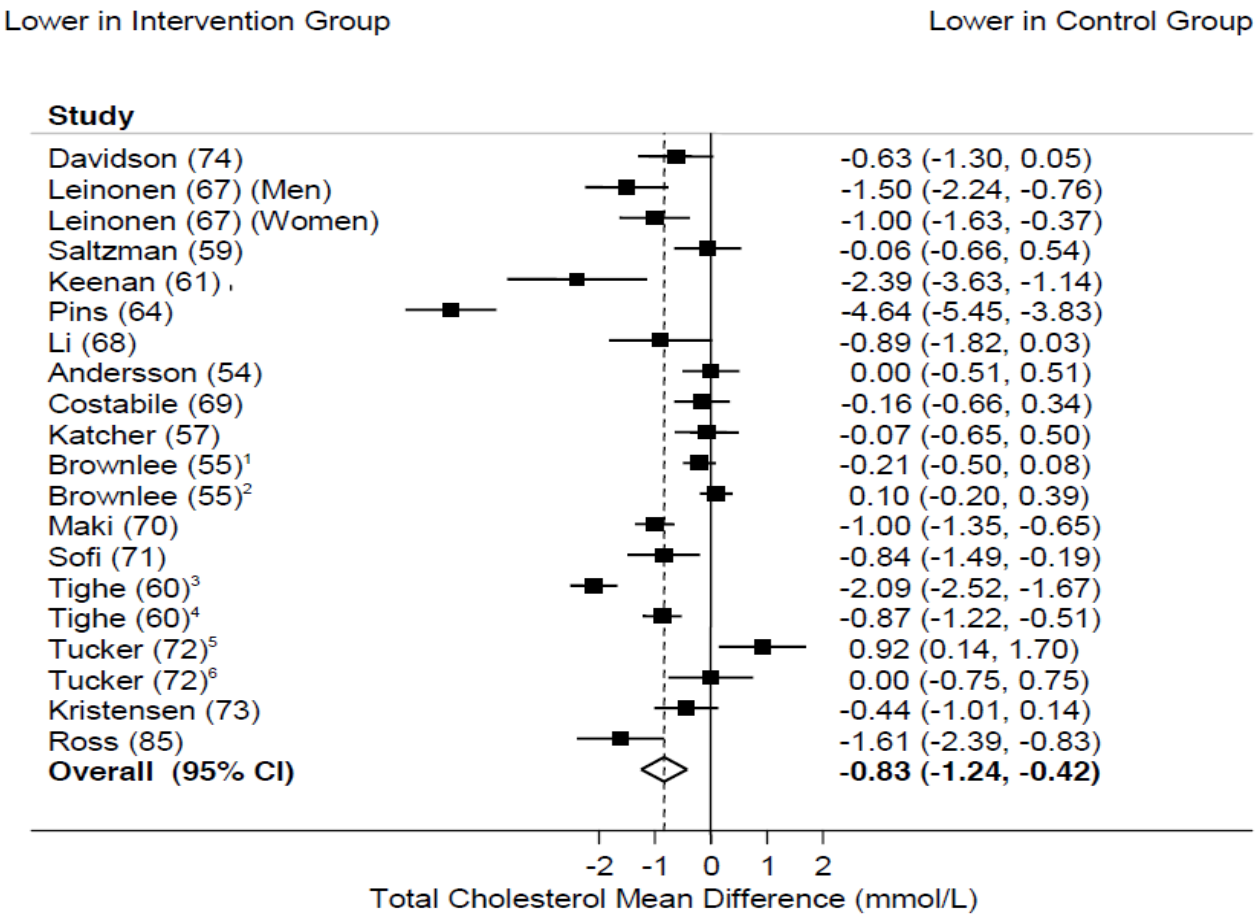
- Prospective cohort studies of disease outcomes
- Randomized trials of surrogate endpoints
- Randomized trials of disease outcomes

Mean difference in post-treatment metabolic markers: whole-grain intervention groups versus controls* (Ye et al, J Nutr 2012;142: 1304)

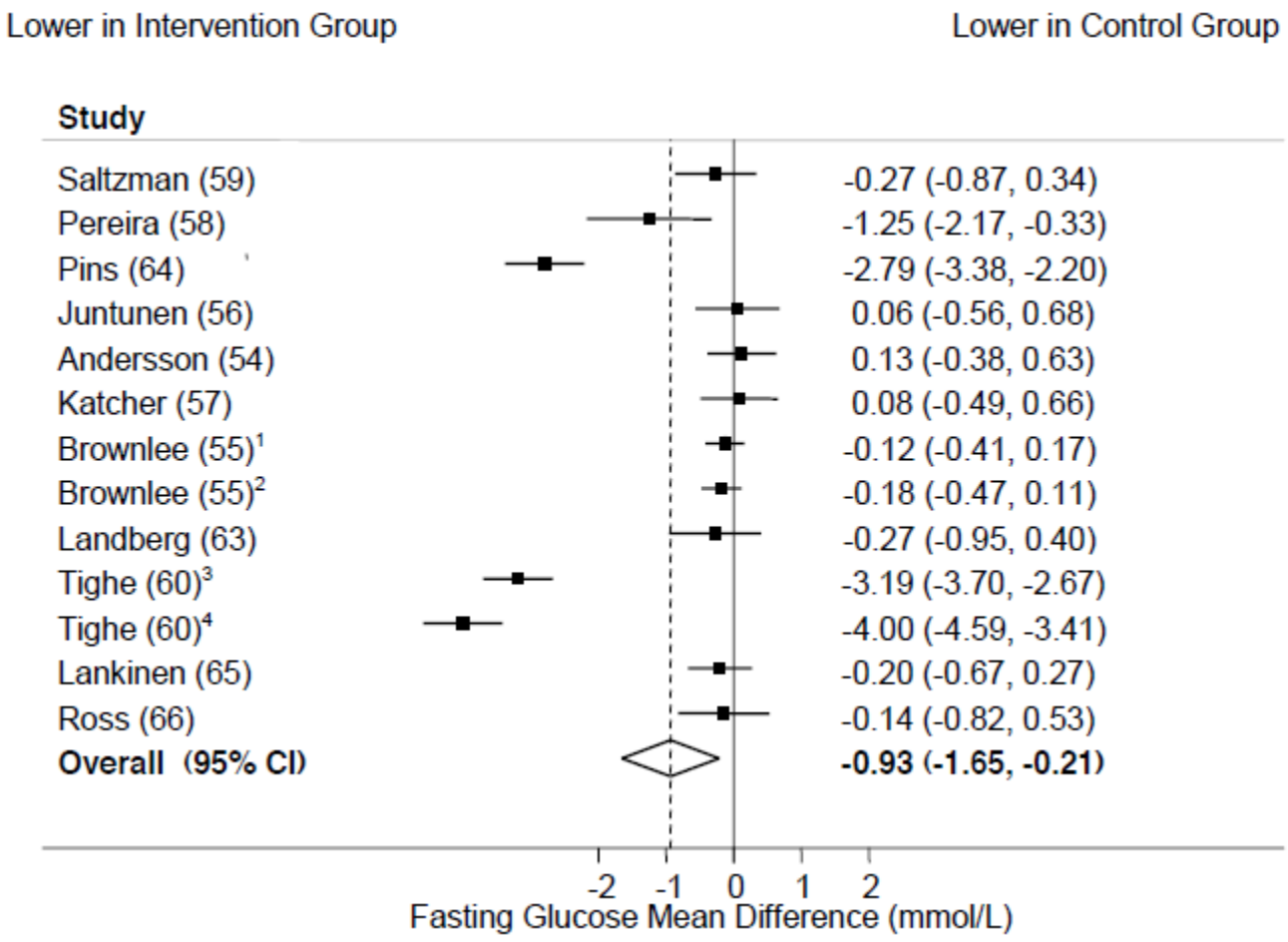
Metabolic biomarkers	Studies, *n*	Weighted mean difference (95% CI)
Fasting insulin, *pmol/L*	10	−0.29 (−0.59, 0.01)
Fasting glucose, *mmol/L*	11	−0.93 (−1.65, −0.21)
Total cholesterol, *mmol/L*	16	−0.83 (−1.24, −0.42)
LDL-cholesterol, *mmol/L*	15	−0.72 (−1.34, −0.11)
Systolic blood pressure, *mm Hg*	6	−0.06 (−0.21, 0.10)
Diastolic blood pressure, *mm Hg*	6	−0.05 (−0.21, 0.11)
Weight gain, *kg*	9	−0.18 (−0.54, 0.18)

*Based on 21 RCT's that directly investigated the effects of whole-grain interventions on one or more metabolic intermediate risk factors.

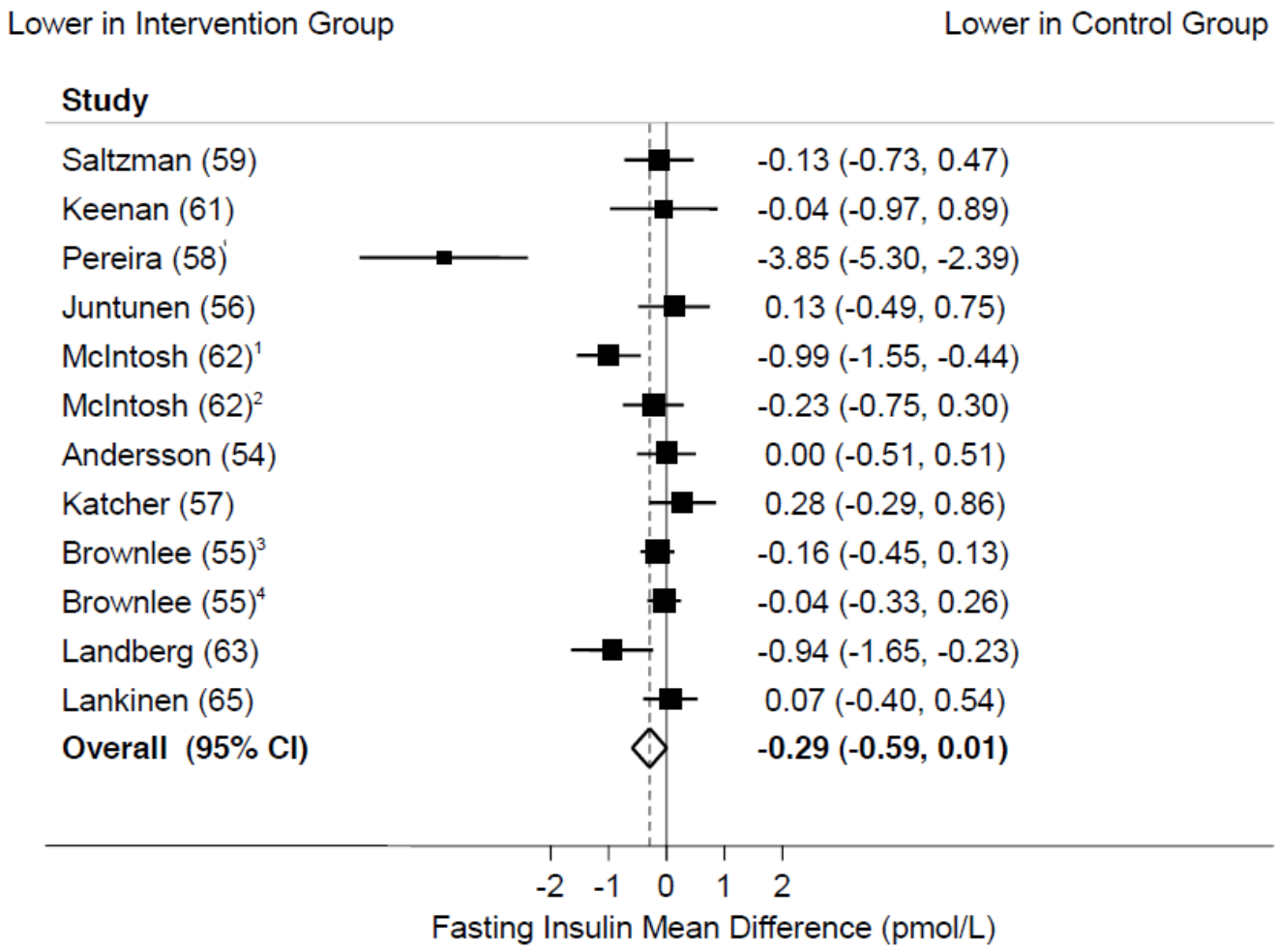
Mean differences (95% CI) in total cholesterol (mmol/L): whole-grain intervention groups versus controls (Ye et al, J Nutr 2012;142: 1304 – online supporting material)



Mean differences (95% CI) in fasting glucose (mmol/L): whole-grain intervention groups versus controls (Ye et al, J Nutr 2012;142: 1304 – online supporting material)



Mean differences (95% CI) in fasting insulin (pmol/L): whole-grain intervention groups versus controls (Ye et al, J Nutr 2012;142: 1304 – online supporting material)



Comparison of intervention vs. observational studies - whole grain and diabetes risk

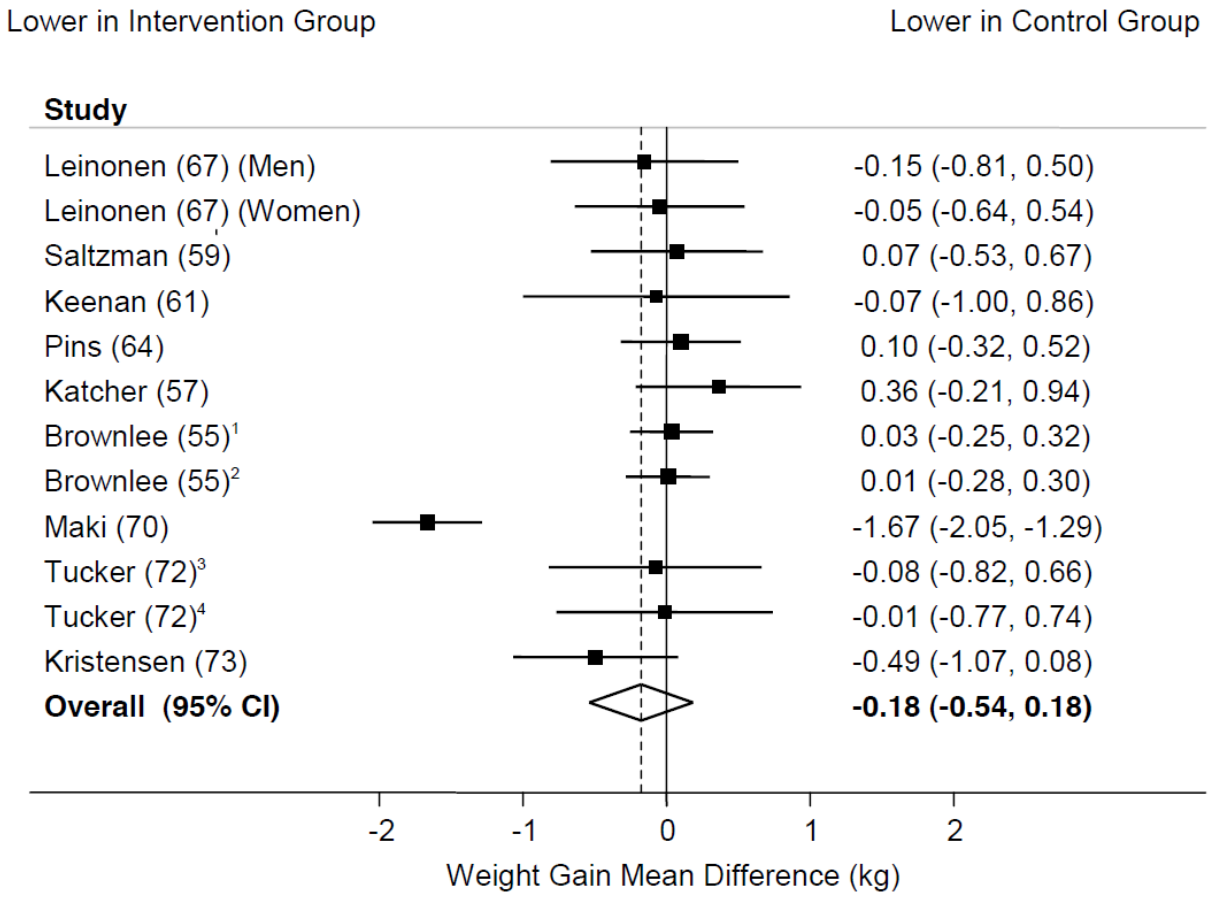
Katcher et al (2008)

- Randomized, parallel study
- 50 obese adults with metabolic syndrome
- Followed 12 weeks
- Whole grain exposure:
  4-7 vs. 0 servings (~64-112 g)/ day as part of hypocaloric diet
- No significant difference between treatment groups for any insulin or glucose measures (fasting, 2 hr OGT, AUC) or for the Insulin Sensitivity Index.

de Munter et al (2007)

- Cohort study
- 161,737 women without diabetes, CVD or cancer
- Followed 12-14 years
- Whole grain exposure:
  31-40 vs. 4-6 gm/d
- 14-25% lower risk of type 2 diabetes

Mean differences (95% CI) in weight gain (kg) whole-grain intervention groups versus controls (Ye et al, J Nutr 2012;142: 1304 – online supporting material)



1 Dosage: 60 g/day; 2 Dosage: 60-120 g/day; 3 Healthy participants; 4 Hyperglycemic participants

Whole Grain Interventions in Trials of Physiologic Measures Examples selected from 21 trials

- high-fiber rye vs white-wheat breads to make up ≥20% of energy
- dietary advice to avoid whole-grain foods vs advice to obtain all grain from whole grains
- hypocaloric diet (maintenance energy minus 4.2 MJ/d) with or without oats at 45 g/4.2 MJ dietary energy
- oat cereal group (standardized to 5.52 g/day beta-glucan) vs a low-fiber cereal control group (less than 1.0 g/day total fiber)
- standard diet (100% of carbohydrates from rice) vs a barley diet (30% carbohydrate from barley and 70% from rice)
- a diet containing 150 g/d of either whole grain bread made from a variety of old grain grown in Tuscany vs commercially available bread
- two portions per day of whole-grain RTE oat cereal (3 g/day oat b-glucan) vs energy-matched low-fiber foods (control), as part of a reduced energy (500 kcal/day deficit) dietary program

Prospective human evidence relating whole grains to disease risk

- Prospective cohort studies of disease outcomes
- Randomized trials of surrogate endpoints
- Randomized trials of disease outcomes

Randomized trials of whole grains and disease outcomes

None

Summary

Current evidence: Do we know more than we think we know?

- Prospective cohort studies
  - show consistent findings for most health outcomes
  - supported by trials of surrogate outcomes for total and LDL cholesterol and fasting glucose.
- Trials of surrogate outcomes
  - Comparability a problem because there are no standard interventions
  - Inconsistency between cohort and trial finding
    - Lack of consistency between trials (interventions)
    - Different paradigm/different hypotheses

Future Directions & Challenges

Future evidence for whole grains and health

- Prospective cohort studies
  - More cohort studies of surrogate endpoints, particularly for weight/waist circumference change
  - Need to consider types of whole grain/whole grain intake in grams
- Randomized intervention trials of surrogate endpoints
  - Focus of future evidence
  - Standardization interventions for comparability among trials
    - Dose response effects
    - Effect of different types of whole grain and interactions between them