Translating Science from the Bench to the Dietary Guidelines

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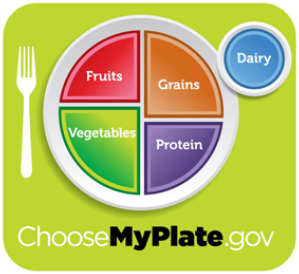


http://www.myplate.gov

Disclosures

Boards –

- **NOF**
- **ILSI**
- **Showalter**
- **Pharmavite**

Grants –

- **NIH**
- **Dairy Research Institute**
- **Nestle**
- **Tate and Lyle**

3 Levels of Decision about Nutrition/Diet Recommendations

1. Individual

2. Physician – Clinical Guidelines

3. Population – DRI/ Dietary Guidelines

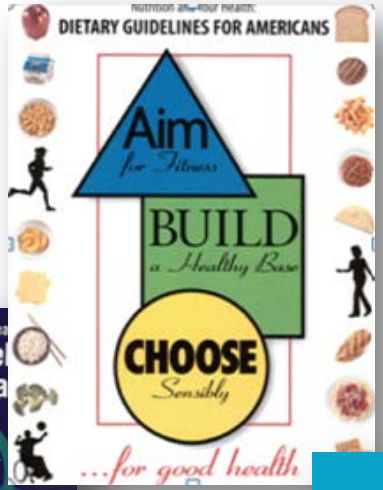
Dietary Guidelines for Americans: The Core of Nutrition Policy

1980

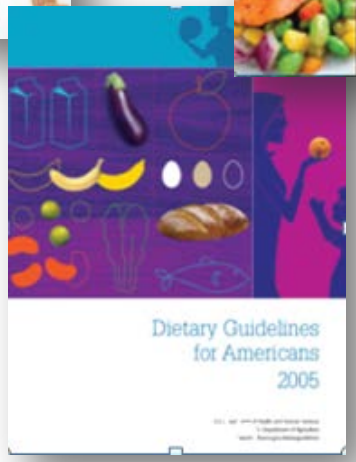
1985

1990

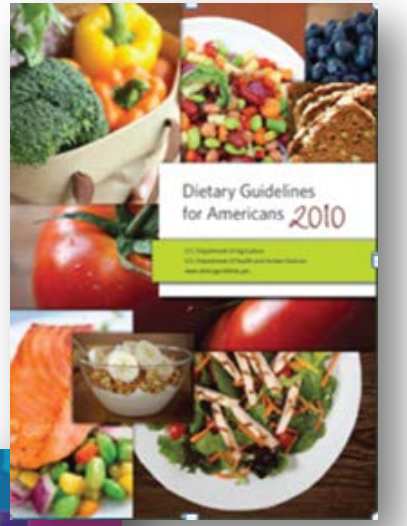
1995



2000



2005



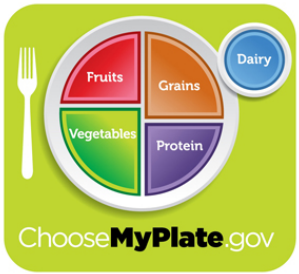
2010

Dietary Guidelines for Americans

Legislative Mandate:

National Nutrition Monitoring and Related Research Act of 1990 (1990) Public Law 445, Section 301

- Dietary guidelines must be issued every 5 years
- Dietary guidance issued by the Federal government for the general public is to be reviewed by the Secretaries of Agriculture, and Health and Human Services. (Departments alternate the lead role.)



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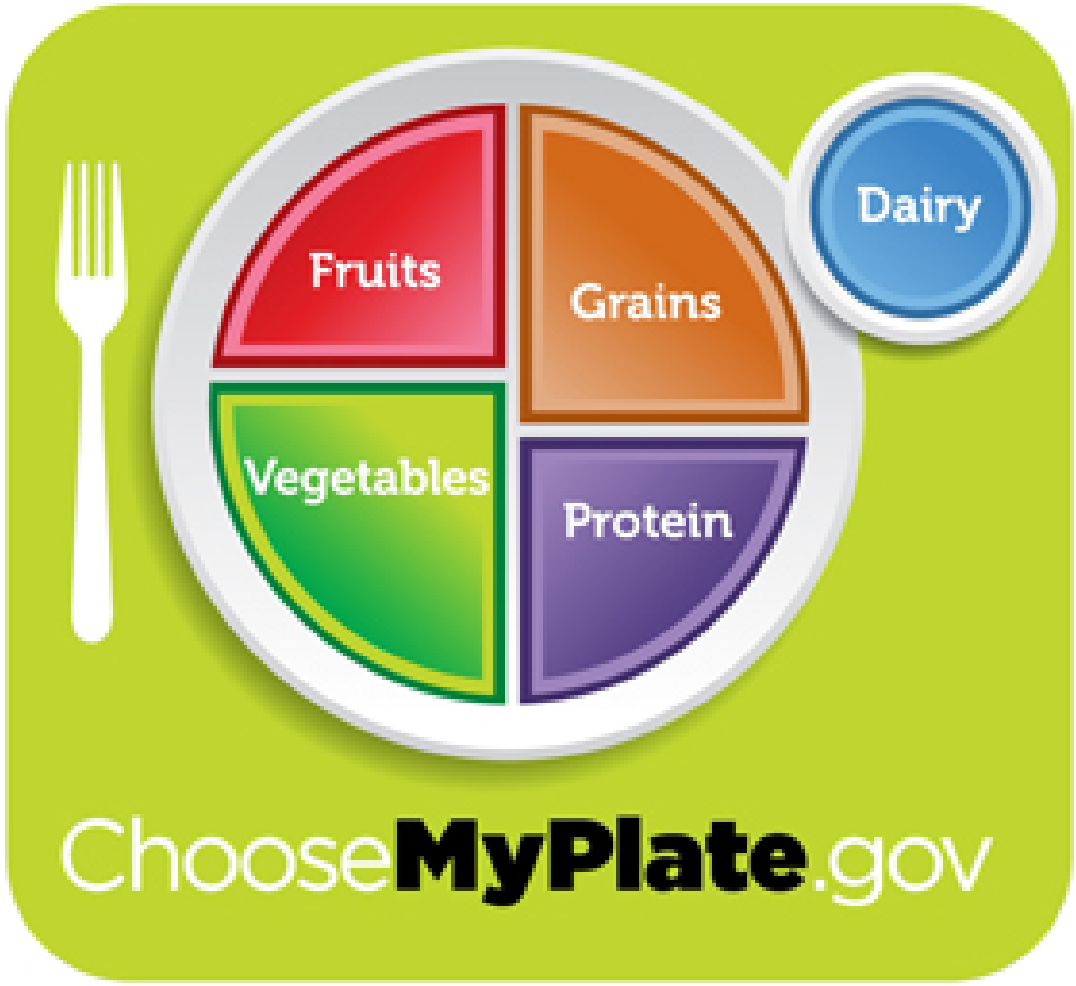
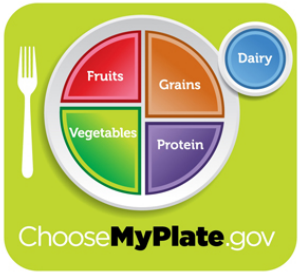
What the Guidelines Do

- Provide dietary advice to consumers
- Set policy for food assistance programs (e.g., school lunches, elderly nutrition)
- Establish overarching goals for
  - National health objectives
  - Nutrition monitoring
  - Nutrition research
- Set framework for standards in
  - Food labeling/ fortification
  - Food product development



http://www.myplate.gov

MyPlate starts with 12 patterns that Americans eat on average and makes changes needed to achieve nutrient recommendations without exceeding calories.

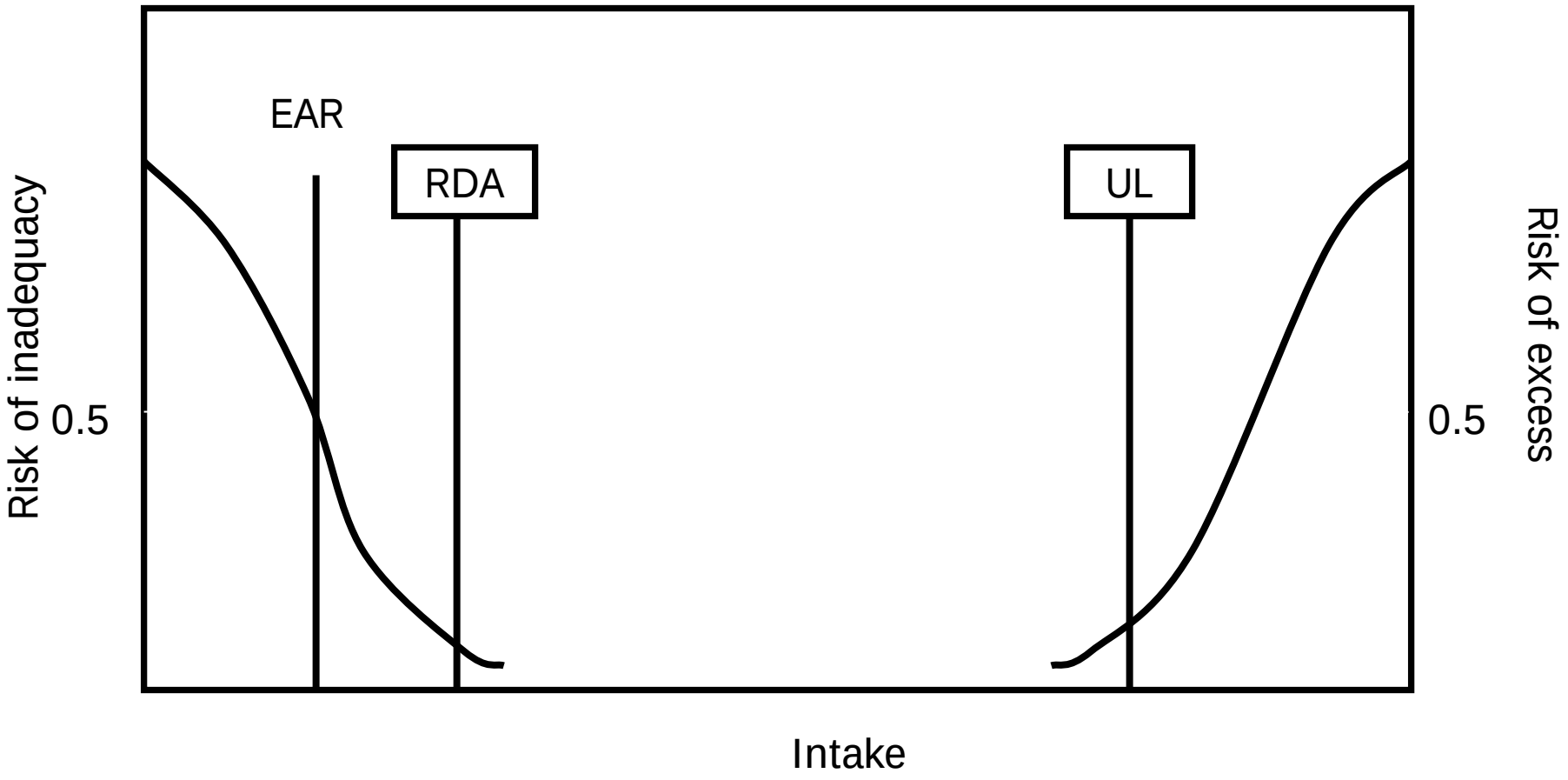


http://www.myplate.gov

DIETARY GUIDELINES FOOD PATTERNS BASED ON

- Food modeling to meet DRIs
- Evidence of relationship of food intake dose to health-RCTs priority

Dietary Reference Intakes



Camp Calcium

Metabolic Studies

What are calcium requirements in adolescents?

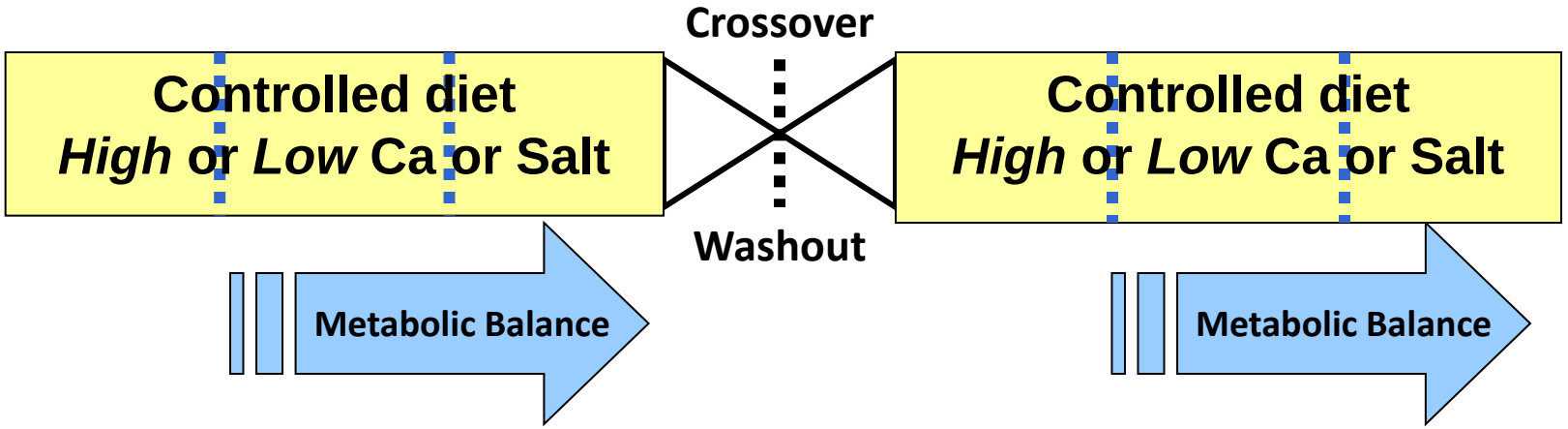
Funded by NIH (NIAMS)


We LOVE the fountain!

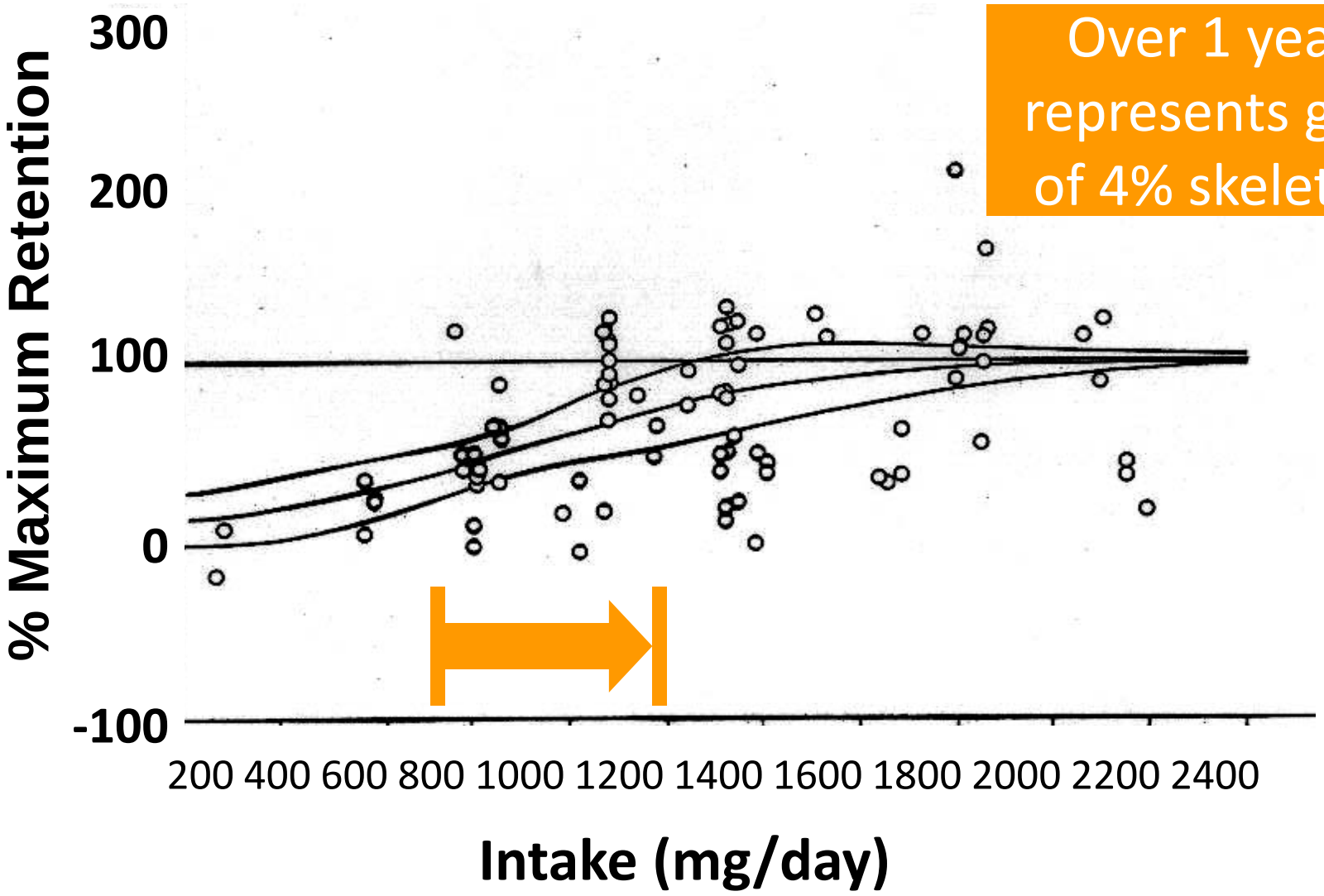

FRESH
VITAMIN D MILK
HALF GALLON (1.89L)


Please refrain
from calling Julia's
name when she is
off duty.
Thank You

Study Design



Maximal Calcium Retention as a Function of Intake



Jackman et al., AJCN, 1997

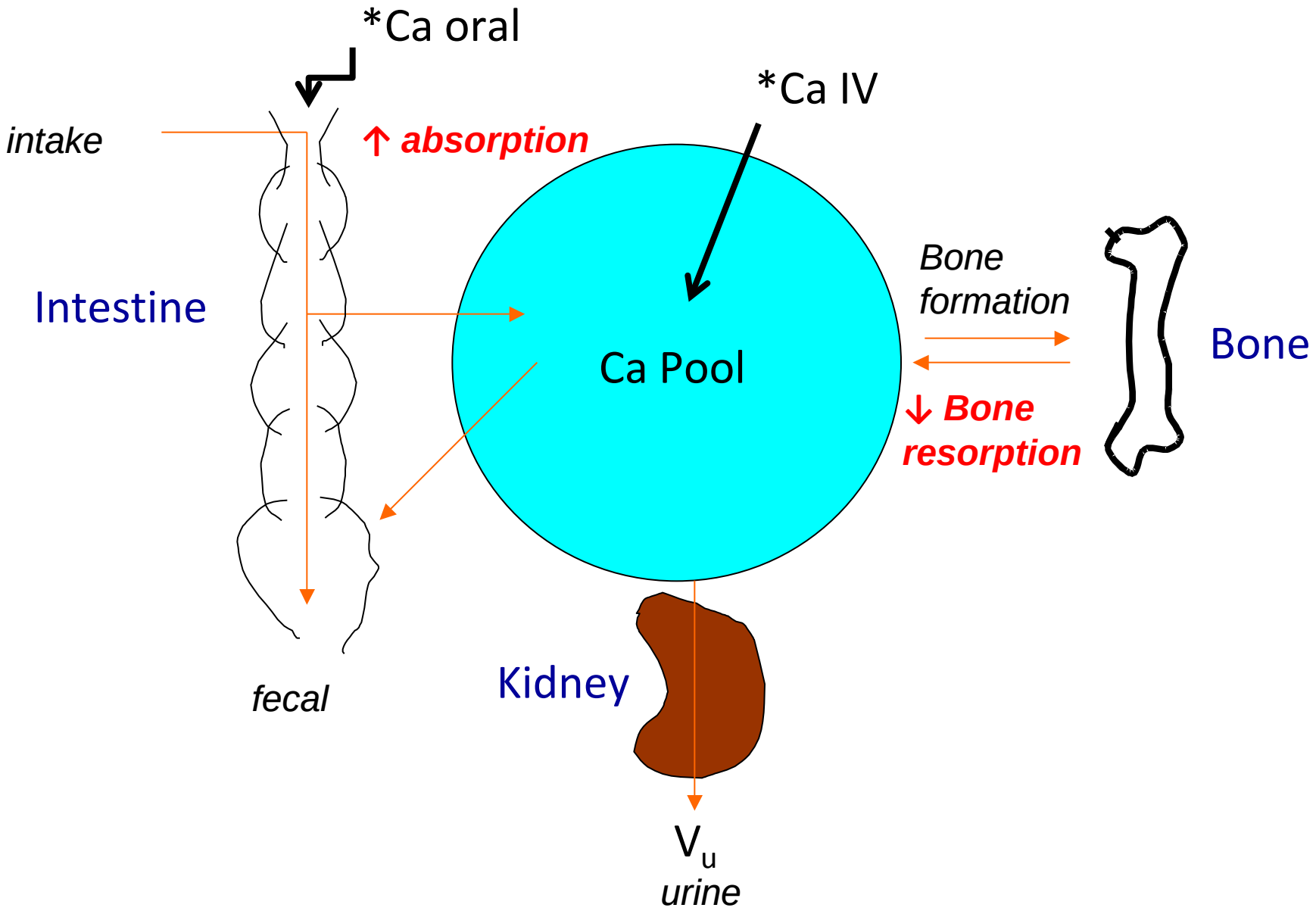
Estimated bone gain from our model increasing Ca intake from 800 → 1300 mg/d:

10 % increase in peak bone mass

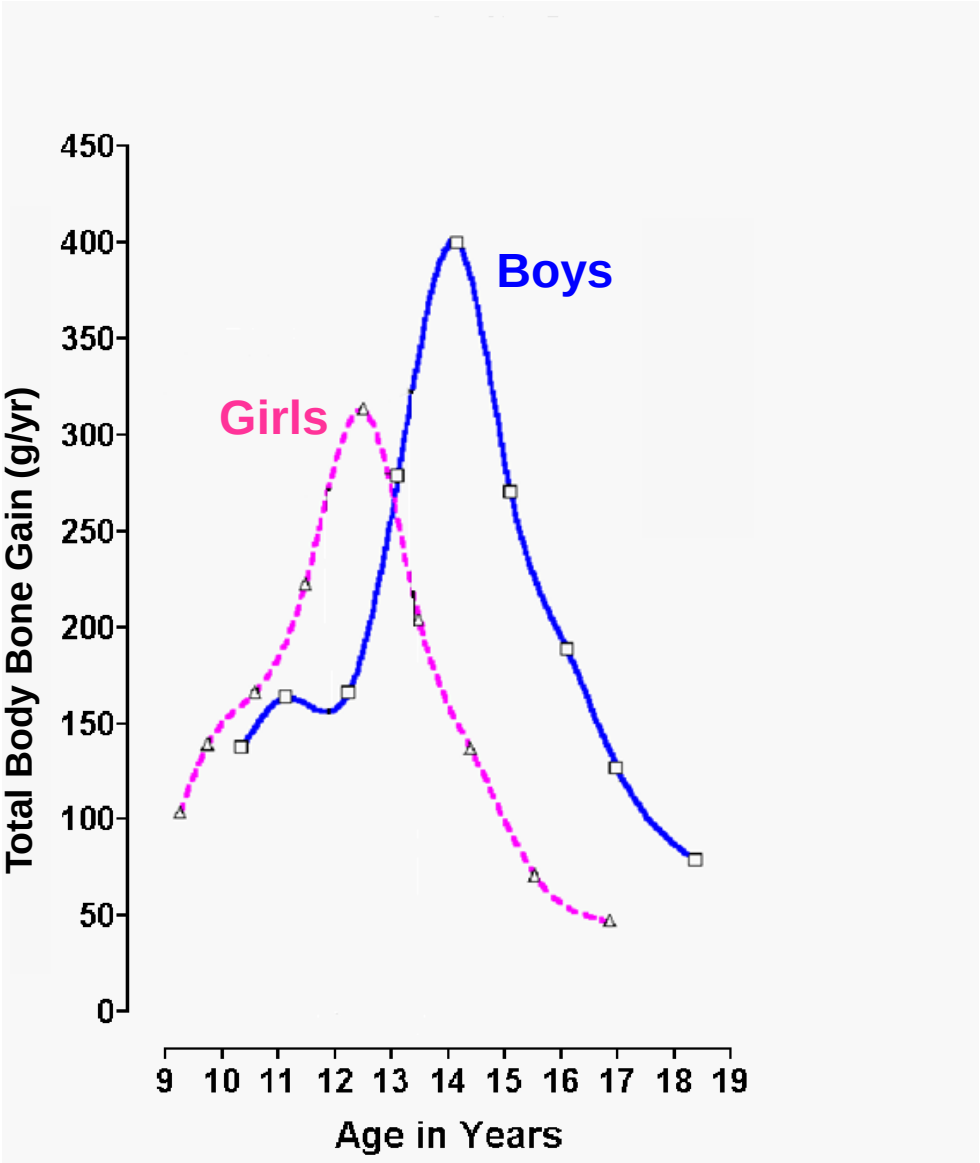
This could delay onset of ***osteoporosis*** by **13 years** and decrease risk of ***fracture*** in postmenopausal women by **50 %**

Bonjour et al., Med Sport Sci 2007; 51: 64; WHO 1994

Effect of Increasing Dietary Calcium



Boys have higher bone accretion than girls



Bailey et al., JBMR 14:711, 1999

Camp Calcium tested whether boys require more calcium for their larger skeletons

Boys matched for Tanner Stage to girls ~3.6

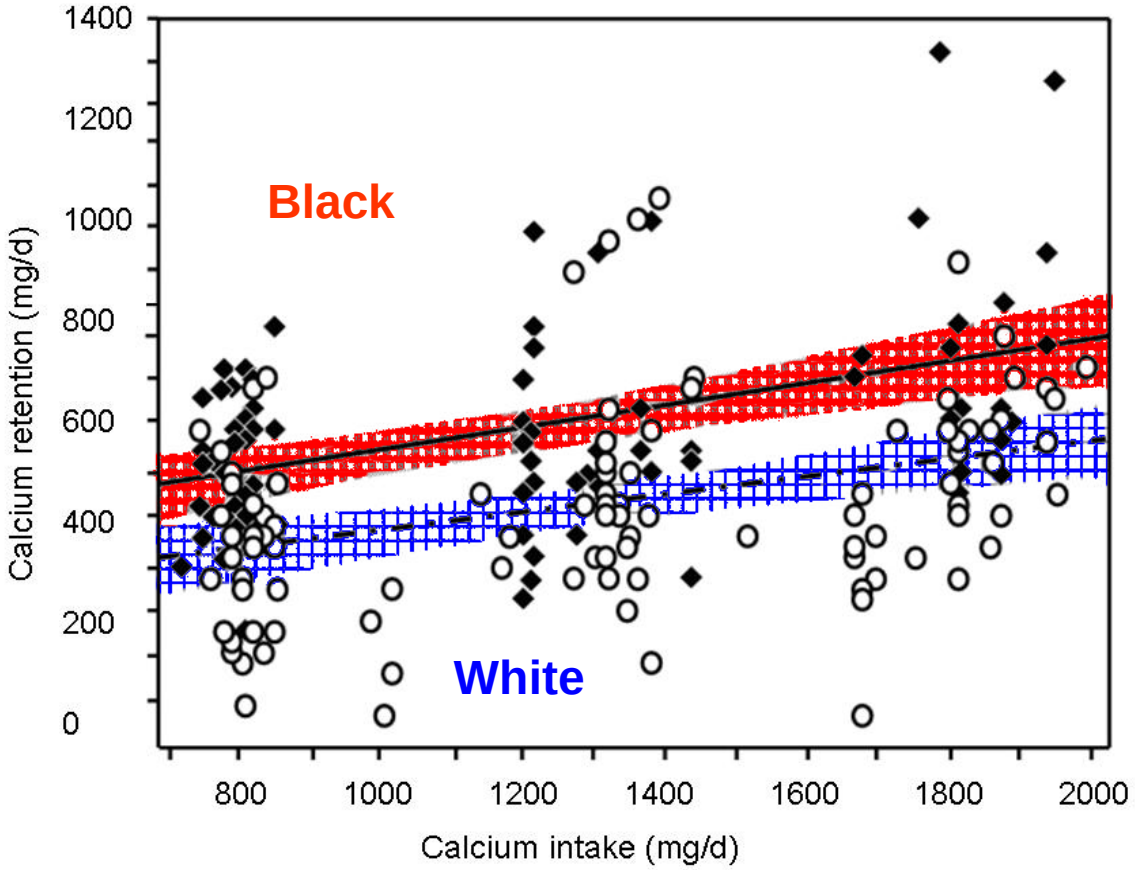
Braun et al., AJCN, 84:4142006

Role of Race?

Differences in Regulators of Calcium Metabolism

Whites have higher Ca intake and Vitamin D status, but lower PTH than other groups.

Diet and race effects on Ca retention in adolescent girls

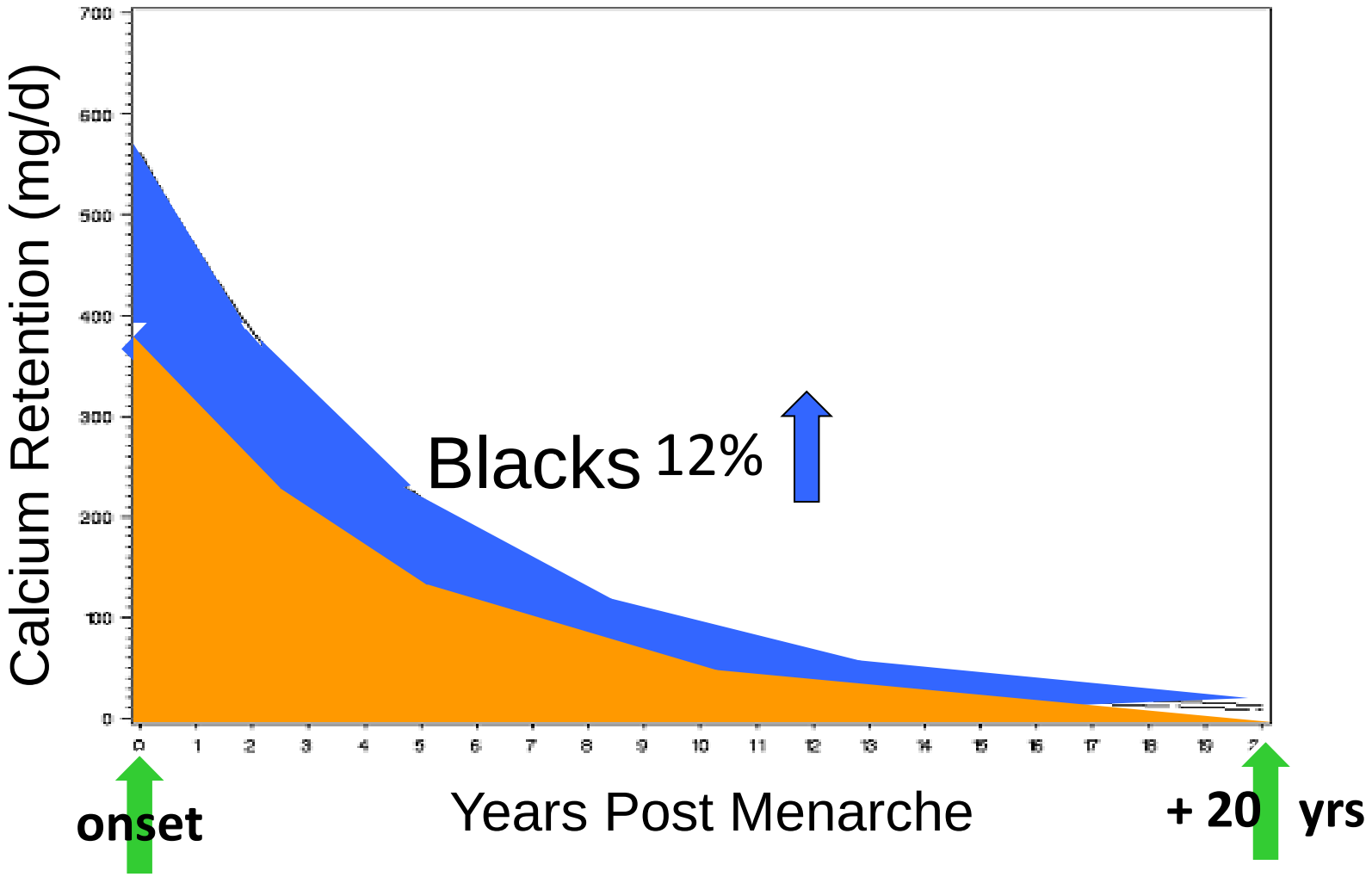


Ca Intake explained 12.3% and Race explained 13.7% Ca retention in adolescent girls

Braun et al. AJCN 85:1657-63, 2007

Camp Calcium

Calcium Retention as a function of postmenarcheal age in black and white females

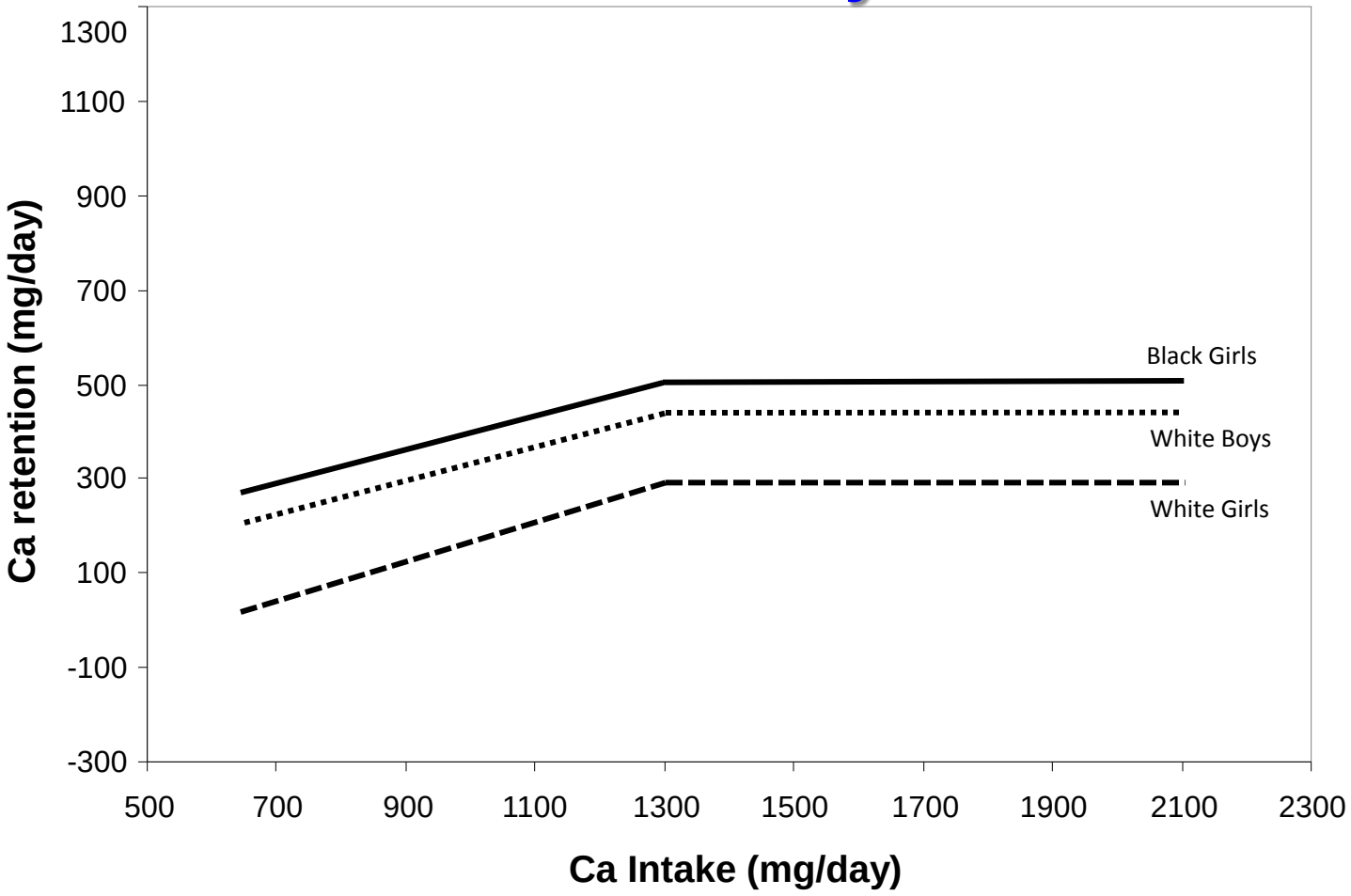


Bryant et al. JCE&M 88:1043, 2003.

In NHANES III,

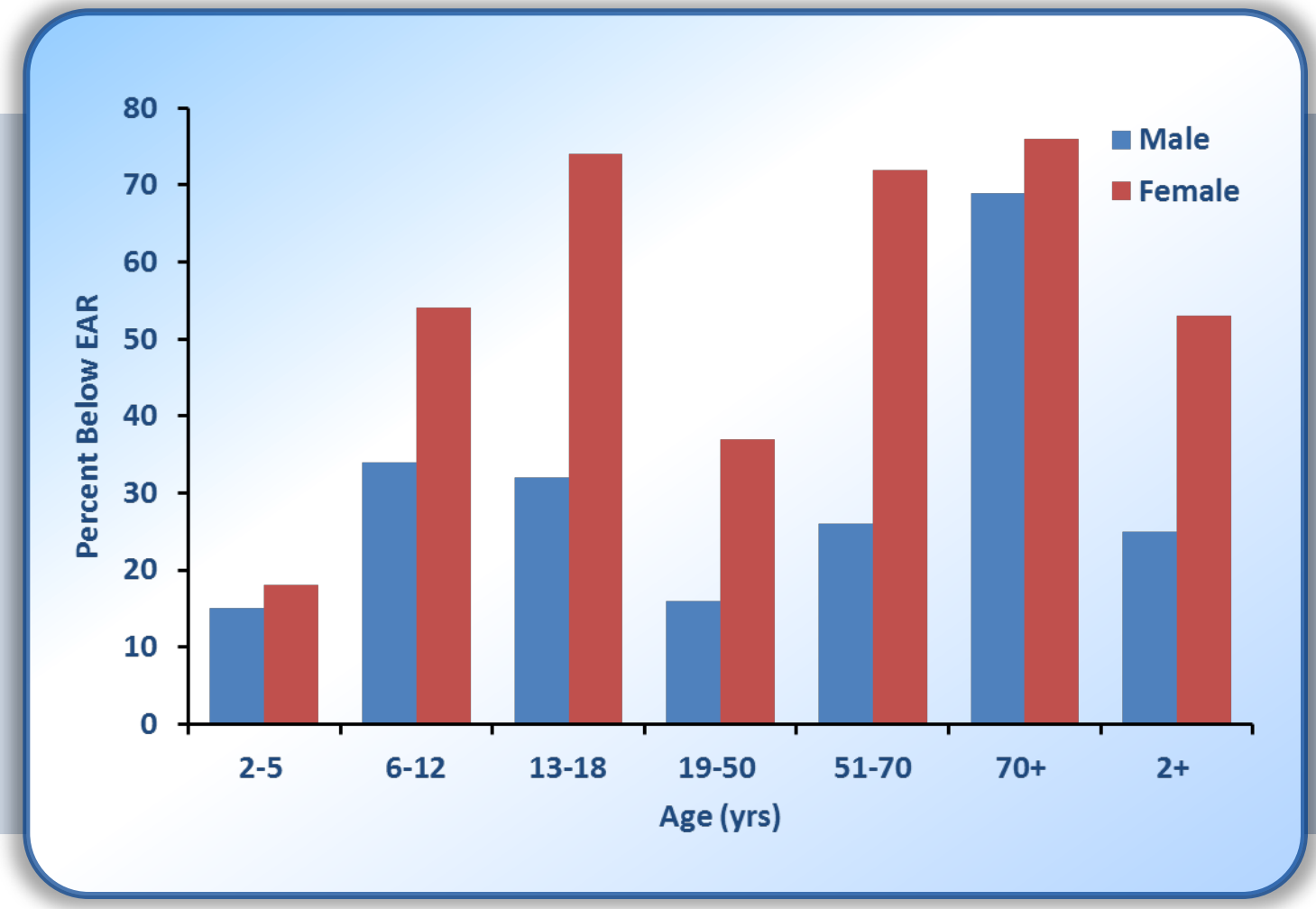
Femoral neck BMC and BMD was 10% and 13% higher, respectively, in adult black than white women

Summary
Calcium retention varies by sex and race



- Blacks acquire more bone mass than whites and boys more than girls
- Calcium retention is influenced by calcium and salt intake and BMI

Nearly 4 out of 10 Americans Don't Consume Enough Calcium



NCI Usual Intake Method, NHANES 2009-2010, Day 1-2, Food sources only,
Percent below estimated average requirement for calcium

Dietary Guidelines for Americans – 2010

- **Shortfall food groups and related nutrients for children and adults**

Vegetables	**Vit A, C, K, Mg**	**Fiber**
Fruits		
Whole grains		
Fluid milk and milk products	**Ca, K, Vit D, Mg, P**	
Oils –Vit E		

Milk Provides Essential Nutrients

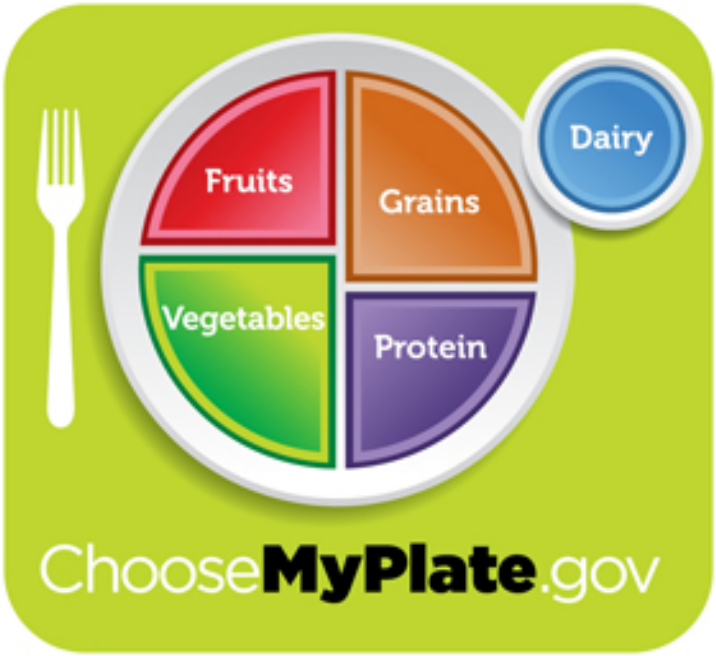
3 cups low-fat milk provide about:	
Calcium	>100%
Phosphorus	99%
Vitamin D	86%
Protein	54%
Riboflavin	32%
Potassium	28%
Magnesium	25%
Vit B, Vit A, Zinc, and more…	

Percentages for vit D and calcium based on EAR, percentages for all others based on RDA

Majority of Americans Falling Short of Dairy Recommendations

- **Dietary Guidelines 2010 recommend 3 cups milk products per day (871/mg Ca)**
  - Go low-fat or fat-free
  - If you don't or can't consume milk, choose lactose-free products or other calcium sources

- **Median Milk Equivalent Intakes in US**
  - 1.6 – adult men
  - 1.2 – adult women
  - 2.3 – adolescent boys, aged 14 - 18 y
  - 1.5 – adolescent girls, aged 14 to 18 y
  - 2.4 – boys, aged 9 to 13 y
  - 1.9 – girls, aged 9 to 13 year



http://www.myplate.gov; Report of the DGAC on the Dietary Guidelines for Americans, 2010

Factors Affecting Bioavailability

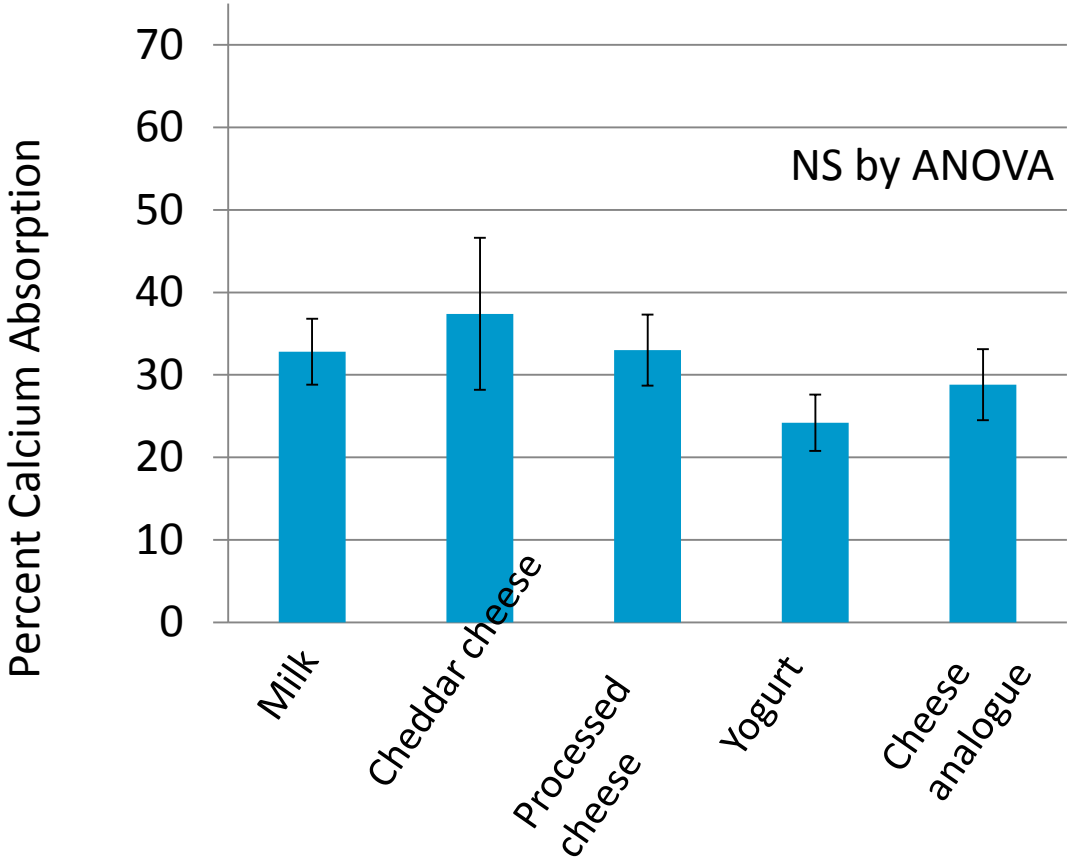
Lifestage

Load

Status

Presence enhancers and inhibitors

Calcium Bioavailability from Dairy Products



- Healthy white women aged 24-42 y
- Milk intrinsically labeled with stable Ca isotopes

Nickel et al J Nutr 126:1406-11, 1996

Calcium Bioavailability from Milk at Different Lifestages

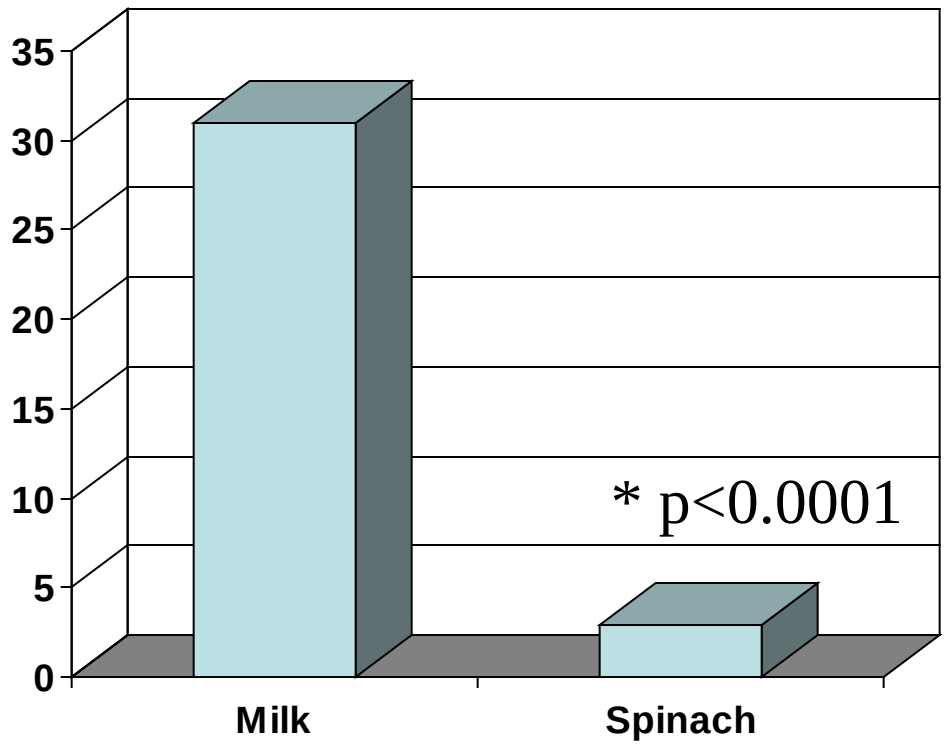
Calcium Absorption ~30%

Calcium Absorption ~40%

Calcium Absorption ~25%

Calcium Absorption ~80%

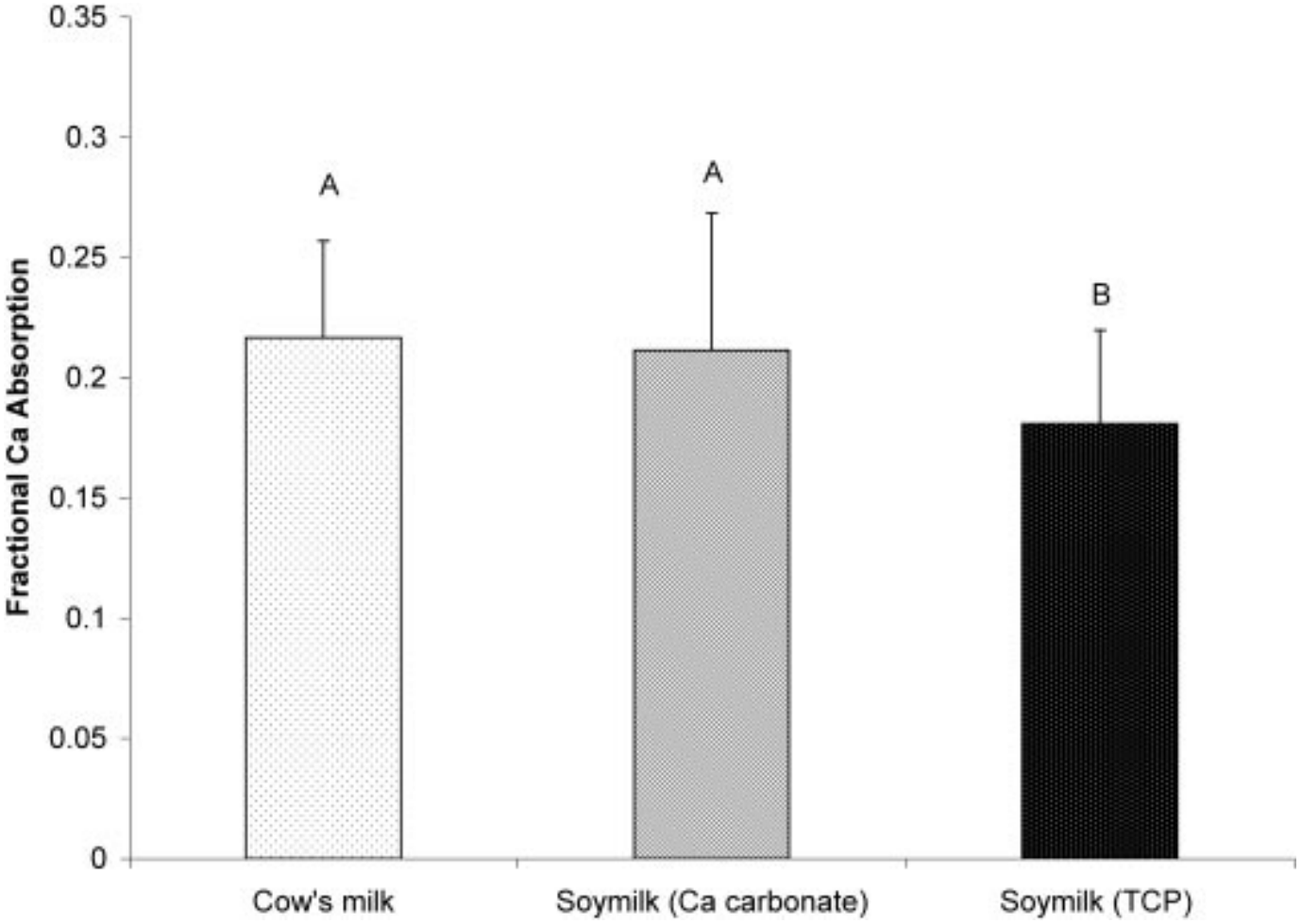
Calcium Absorption (%)



Nickel et al. J Nutr 126:1406, 1996

Weaver and Heaney Calcif Tissue Int. 49:244, 1991

Fractional calcium absorption from fortified soy beverage compared to milk in young women



This led to inclusion in school lunch program.

Zhao et al. J Nutr 135:2379-2382, 2005

Public Impact

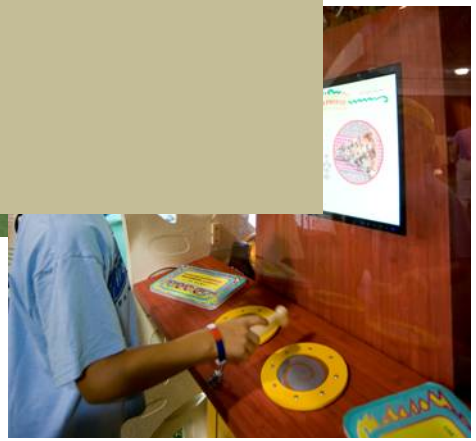
Data determined the calcium requirements for adolescents for North America – 1997

Used for 2004 Surgeon General's Report on Bone Health

Used for 2005 Dietary Guidelines

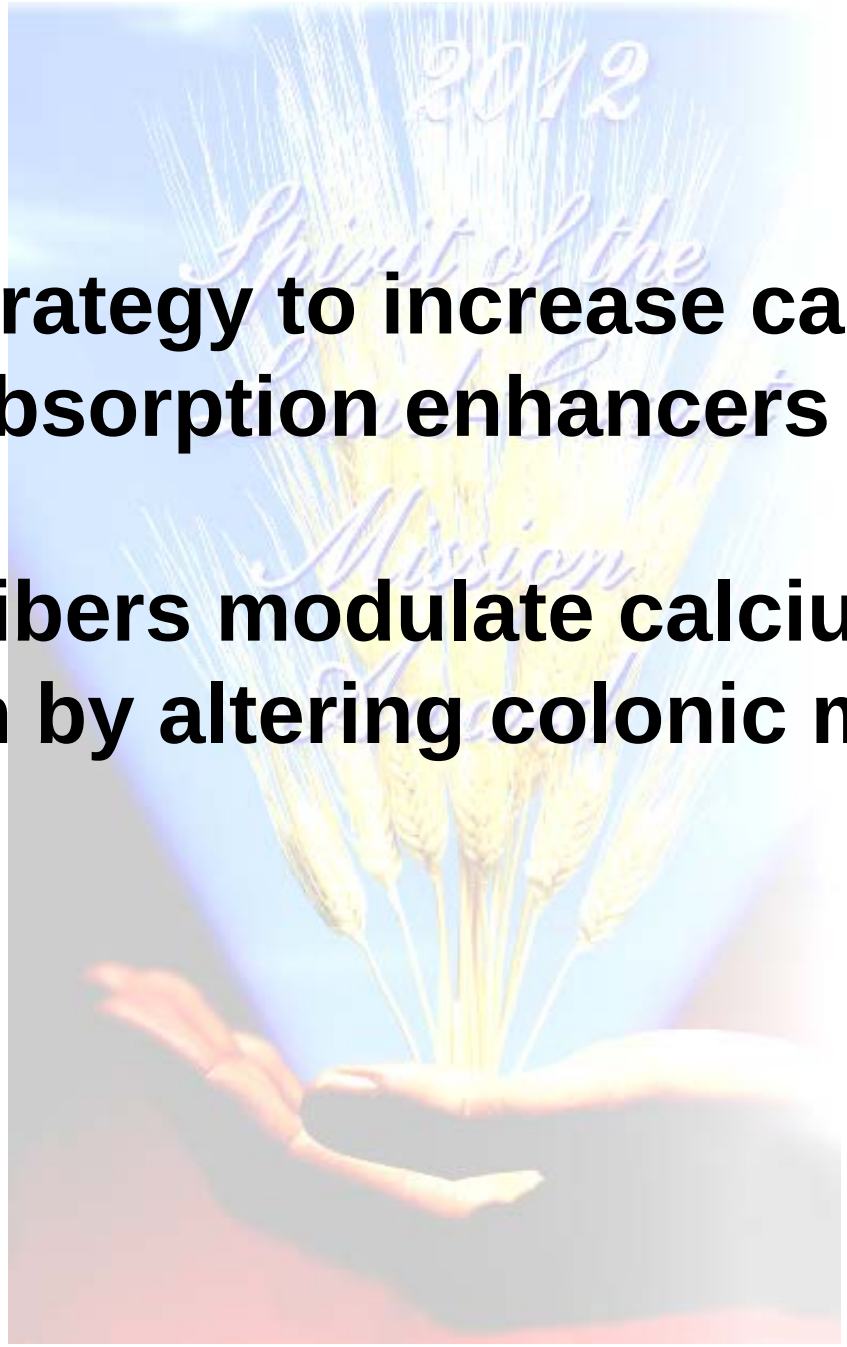
2008 State Fair Exhibit *The Bone Zone*

- Created from Indiana Dairy and Nutrition Grant
- Won People's Choice Award at Congressional Staff Meeting
- Traveling exhibit to Children's Museums in IN, TN, KY, SC. Scheduled through 2013.



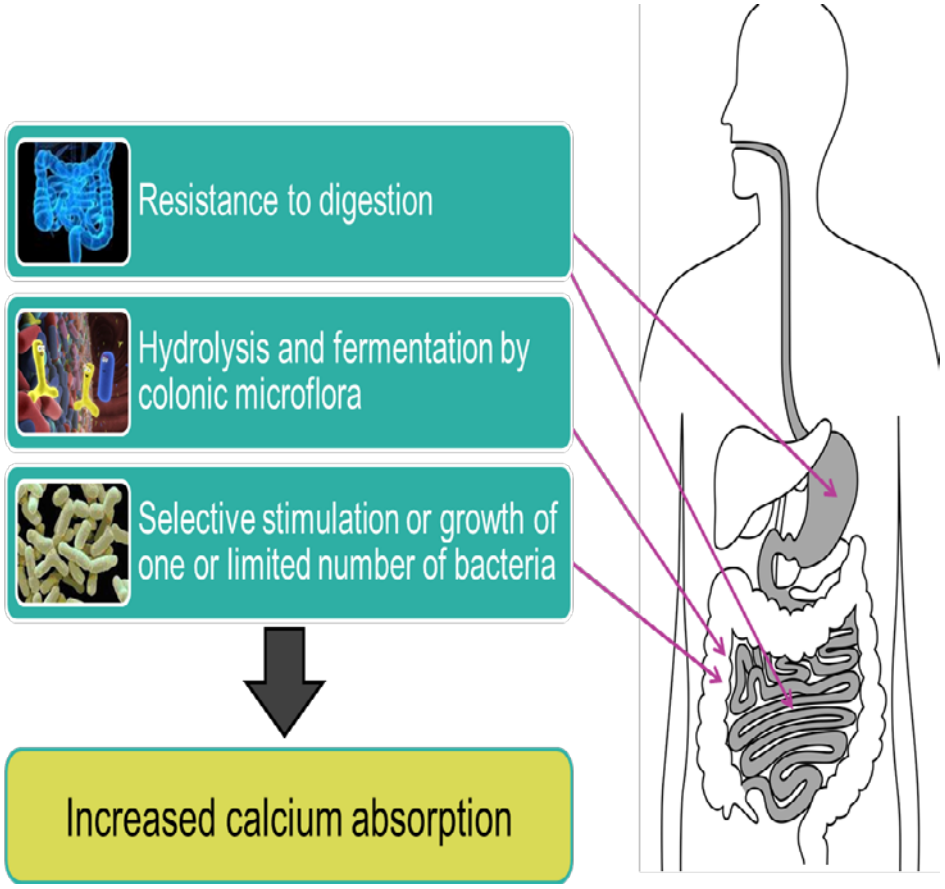
Another strategy to increase calcium nutrition absorption enhancers

Prebiotic fibers modulate calcium absorption by altering colonic microbiota



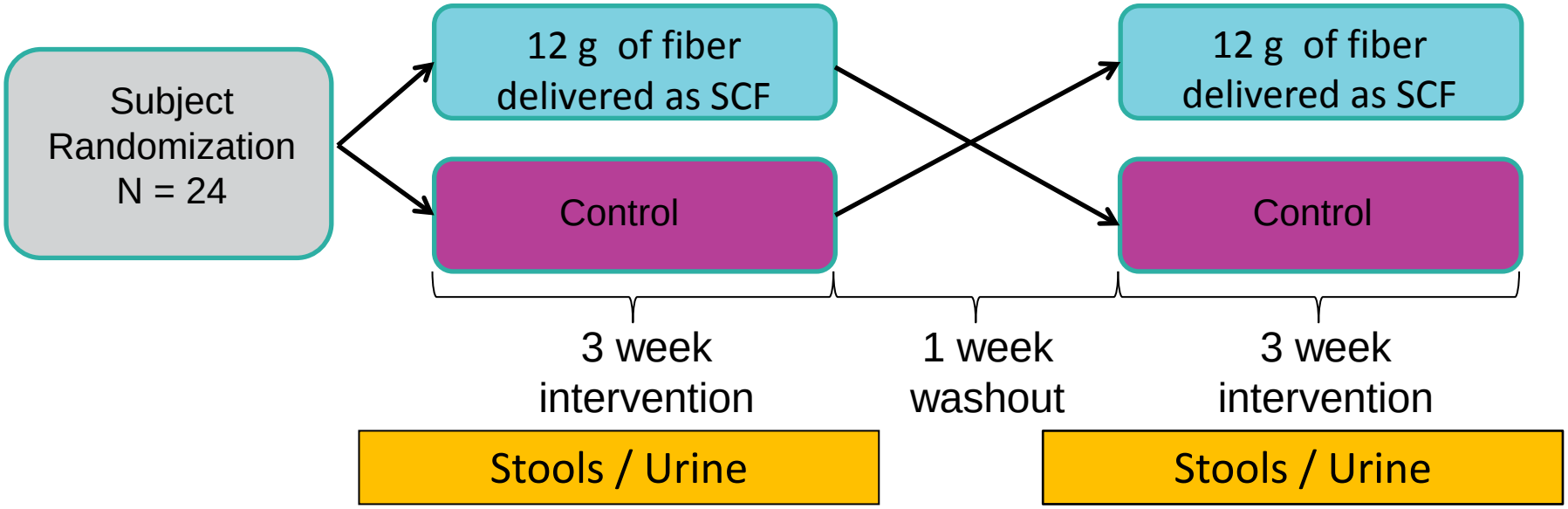
Functional Fibers and Mineral Metabolism

- **Novel dietary fibers / prebiotics improve mineral absorption through unique interactions with colonic microflora.**
- **PROMITOR® Soluble Corn Fiber (SCF) increases calcium absorption in adolescent boys and girls.**
- **Precise mechanism by which SCF influences calcium utilization in adolescents has not been elucidated.**



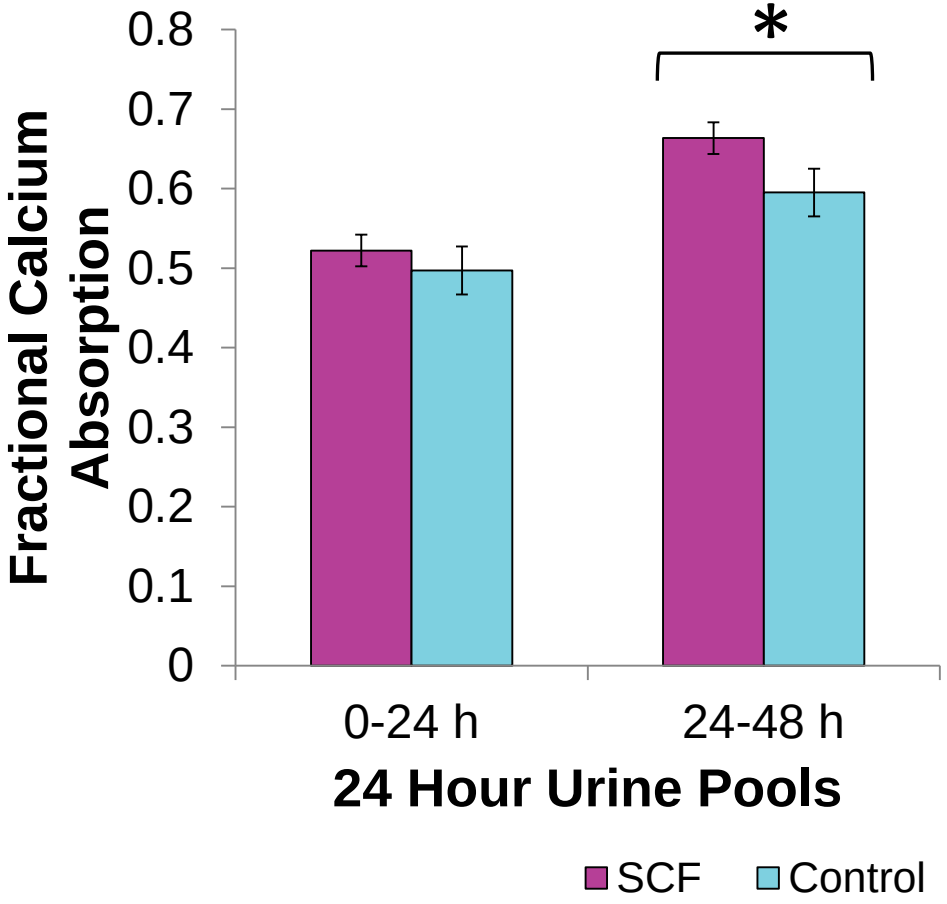
Study Design Testing Soluble Corn Fiber

- Adolescent girls (n=9; age12-14 y) and boys (n=15; age 13-15 y)
- Double-blind, randomized controlled crossover
- Two 3-week metabolic balance periods
- Controlled diets with 600 mg/d calcium
- and 20 g/d fiber (not including SCF)
- PROMITOR® SCF in fruit snacks

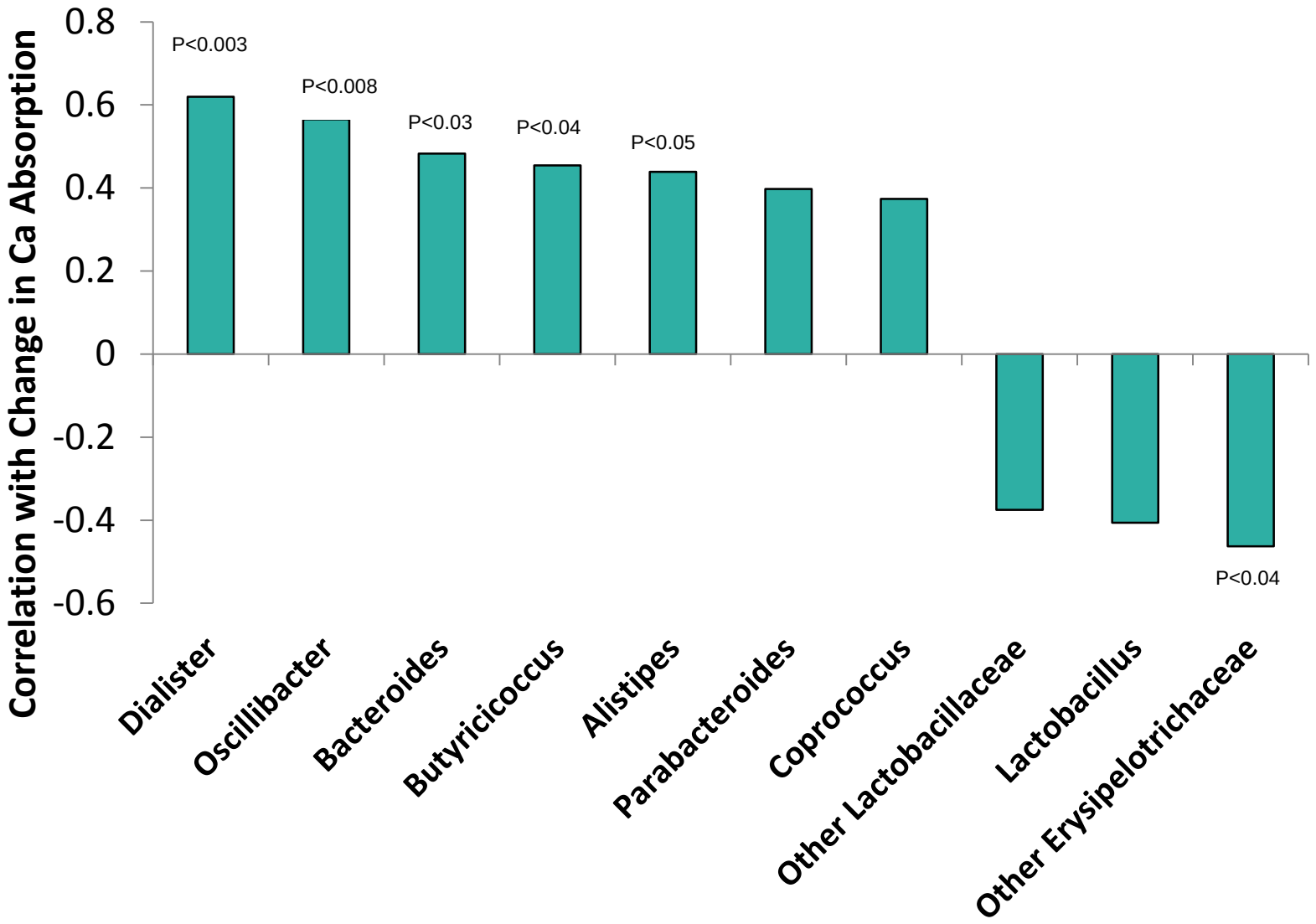


SCF influenced late phase absorption

- **Calcium absorption increased by 12% with SCF consumption compared to Control**
- **Calcium absorption for SCF was higher than for Control at 24-48 h (**P*=0.02)**
- **Time effect consistent with lower gut absorption**



Calcium Absorption correlated with Fermenters

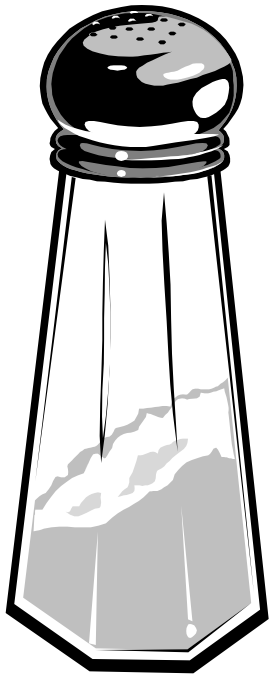


Conclusions

- **First study to show that increases in these specific bacteria were significantly correlated with the observed increase in calcium absorption.**
- **SCF may be acting through short chain fatty acid mechanisms to increase calcium absorption.**
- **Consuming PROMITOR® SCF during the adolescent growth spurt poses a potential opportunity to influence peak bone mass via increasing calcium absorption.**

Nutrient Interactions

Calcium and Sodium



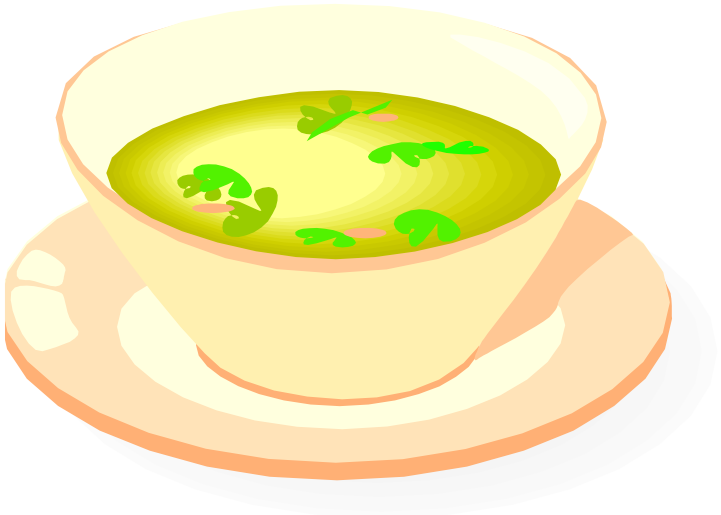
Effect of dietary salt in calcium retention

- Metabolic balance study
  - -Randomized order high/low salt

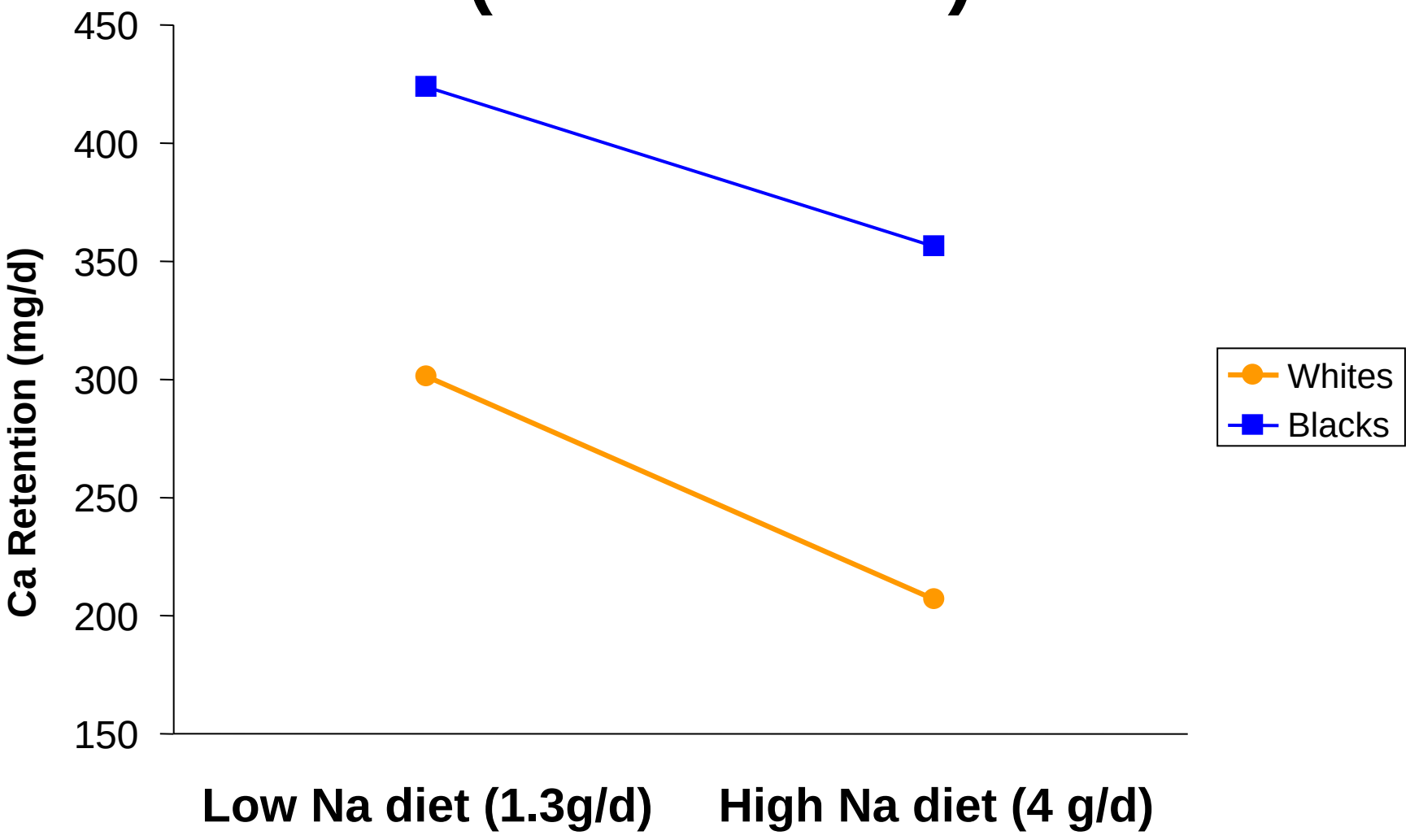
- Adolescent black and white subjects matched for size and sexual maturity

Dietary salt varied

Low Na diet → 1.3 g/d
High Na diet → 4 g/d

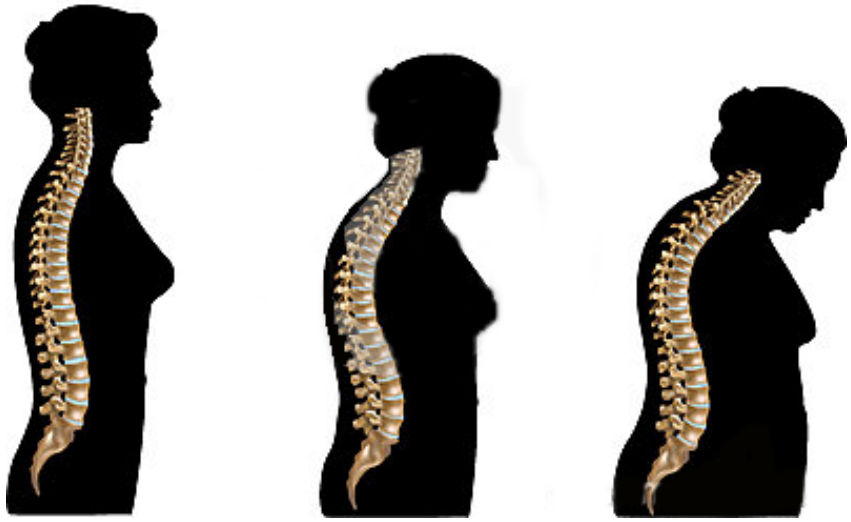


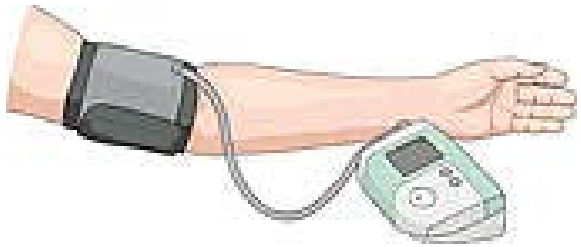
Calcium retention
(Mean ± SEM)



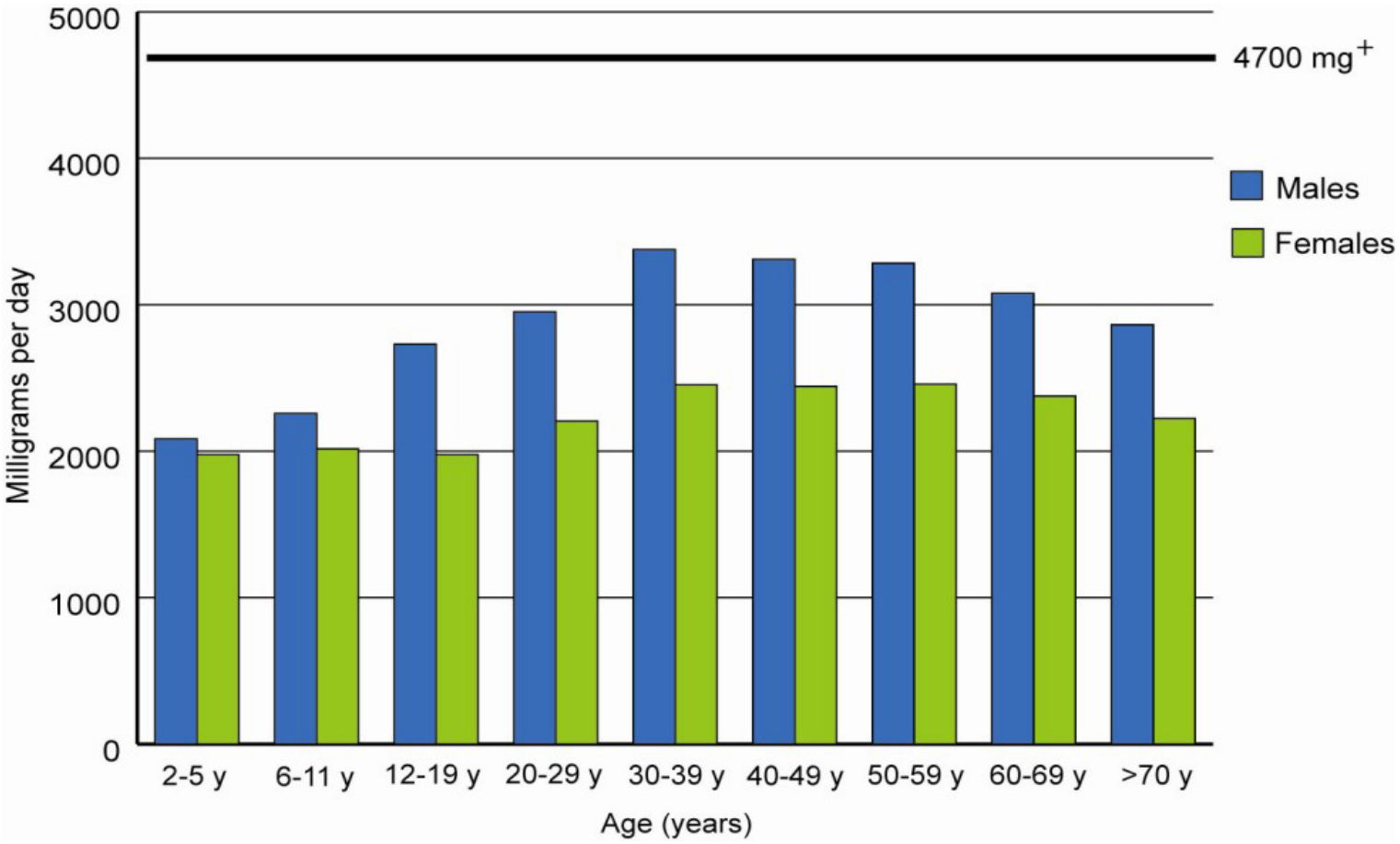
* p<0.05 for diet and race

Calcium and sodium metabolism in adolescent white and black girls appears to predict racial differences in prevalence of hypertension and osteoporosis.





Average K Intake Compared to Recommended Intakes



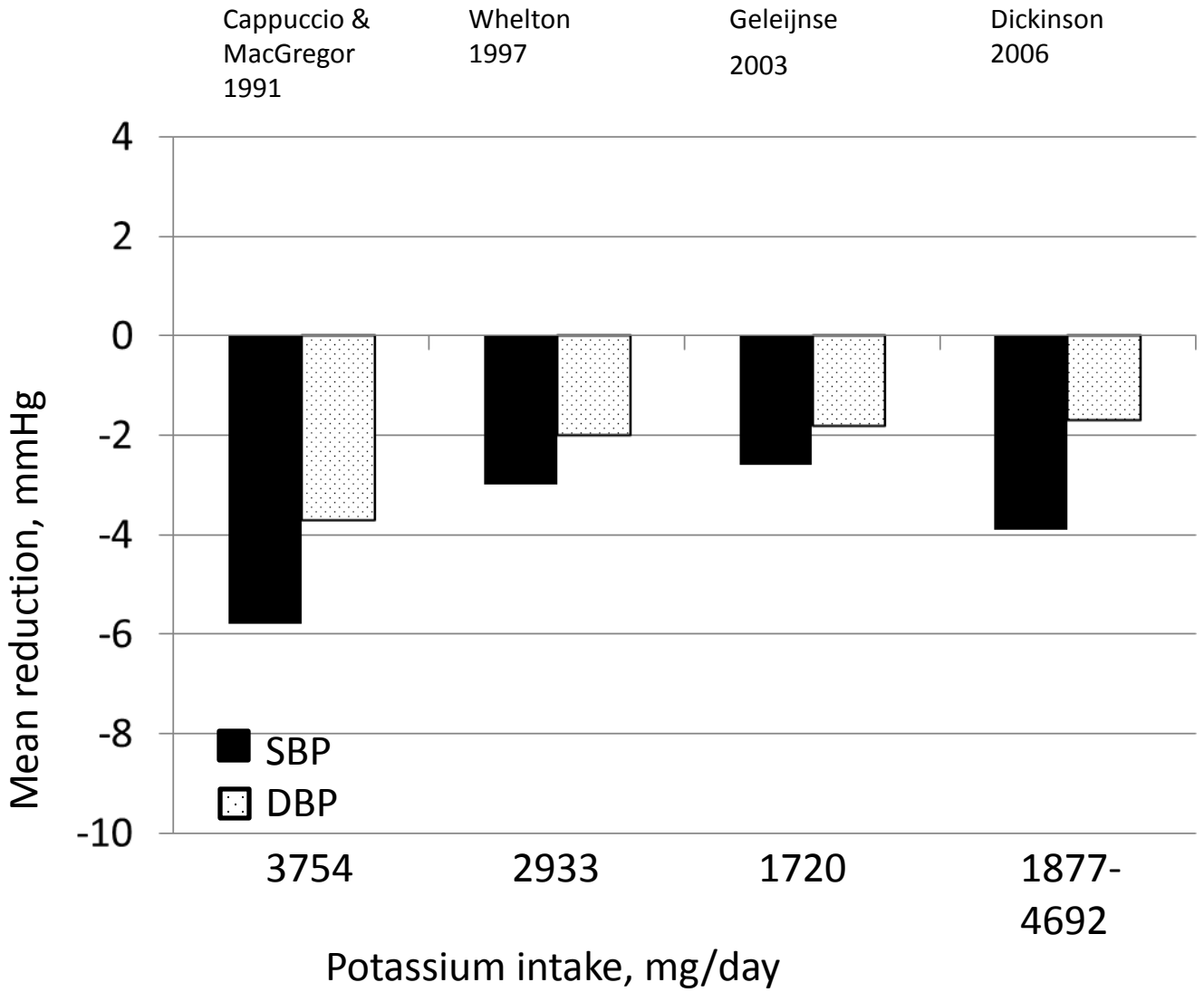
+ 4700 mg is the Adequate Intake (AI) for potassium intakes set by the IOM. For children younger than 14 years old, the AI is less than 4700 mg per day.

Source: USDA, ARS, 2005-2006. WWEIA, NHANES. http:/www.ars.usda.gov/Services/docs.htm?docid=13793.

Only 3 % of Americans met the AI for potassium 2003-2006 NHANES

Fulgoni et al., J Nutr 141:1847, 2011

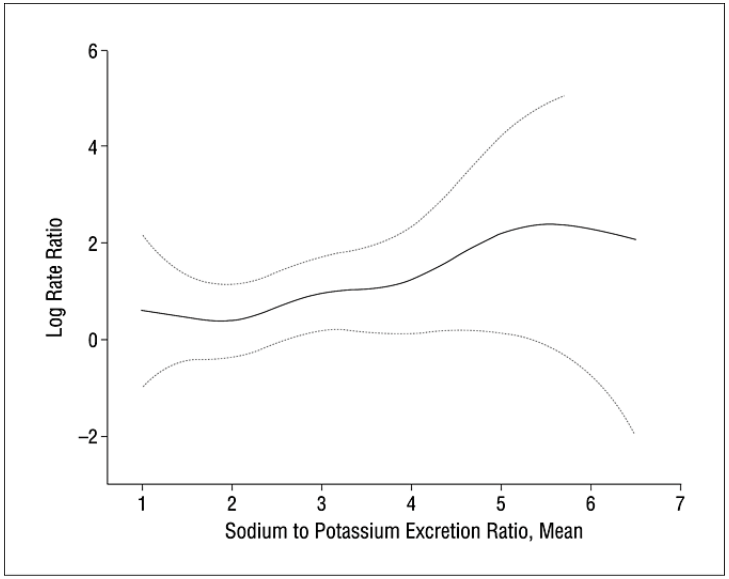
Meta-analyses of studies investigating the blood pressure-lowering effects of potassium



Houston Curr Hypertens 17:471, 2003

Nutrient Interactions

Urinary Na/K Ratio

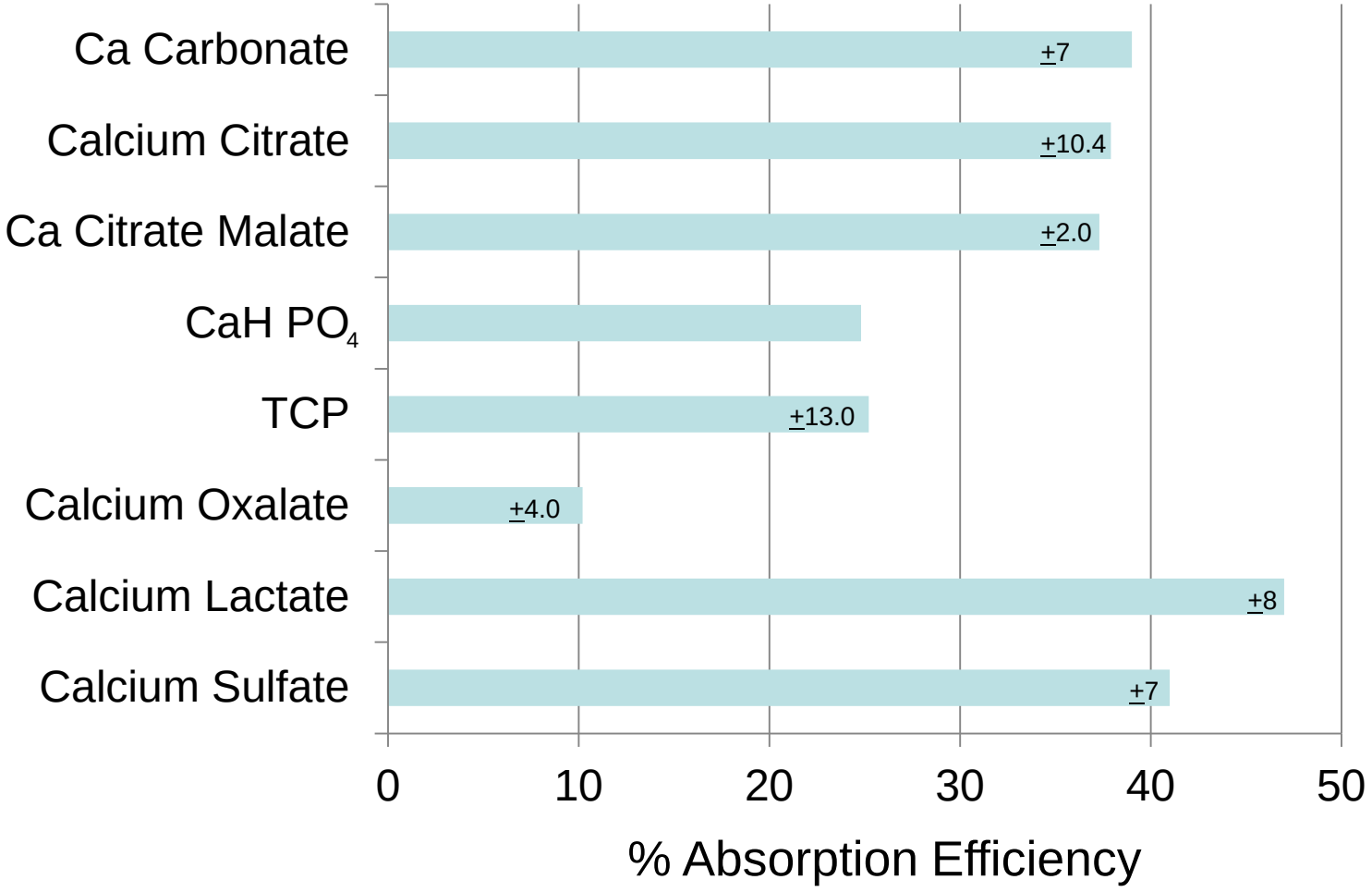


- Benefits:
  - Incorporates both Na and K
  - "Corrects" for incomplete urine collections
  - Was shown to predict BP more strongly and consistently than Na excretion in several studies (including INTERSALT and TOHP I)
  - Was shown to predict CVD better than Na or K excretion alone in the TOHP trials

Cook, N. R. et al. Arch Intern Med 2009;169:32-40.

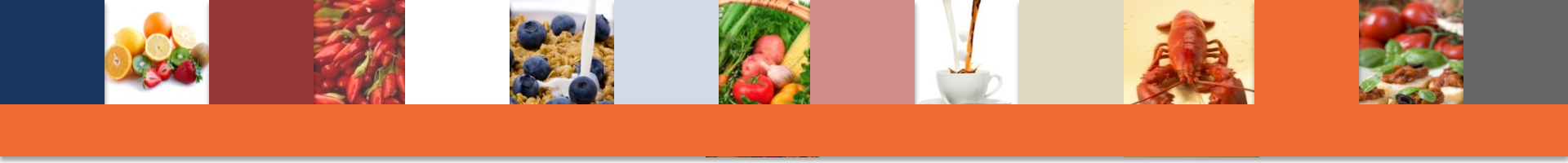
Does the source matter?

Calcium Absorption Efficiency from Various Salts at Loads of 200-300 mg in Premenopausal Women

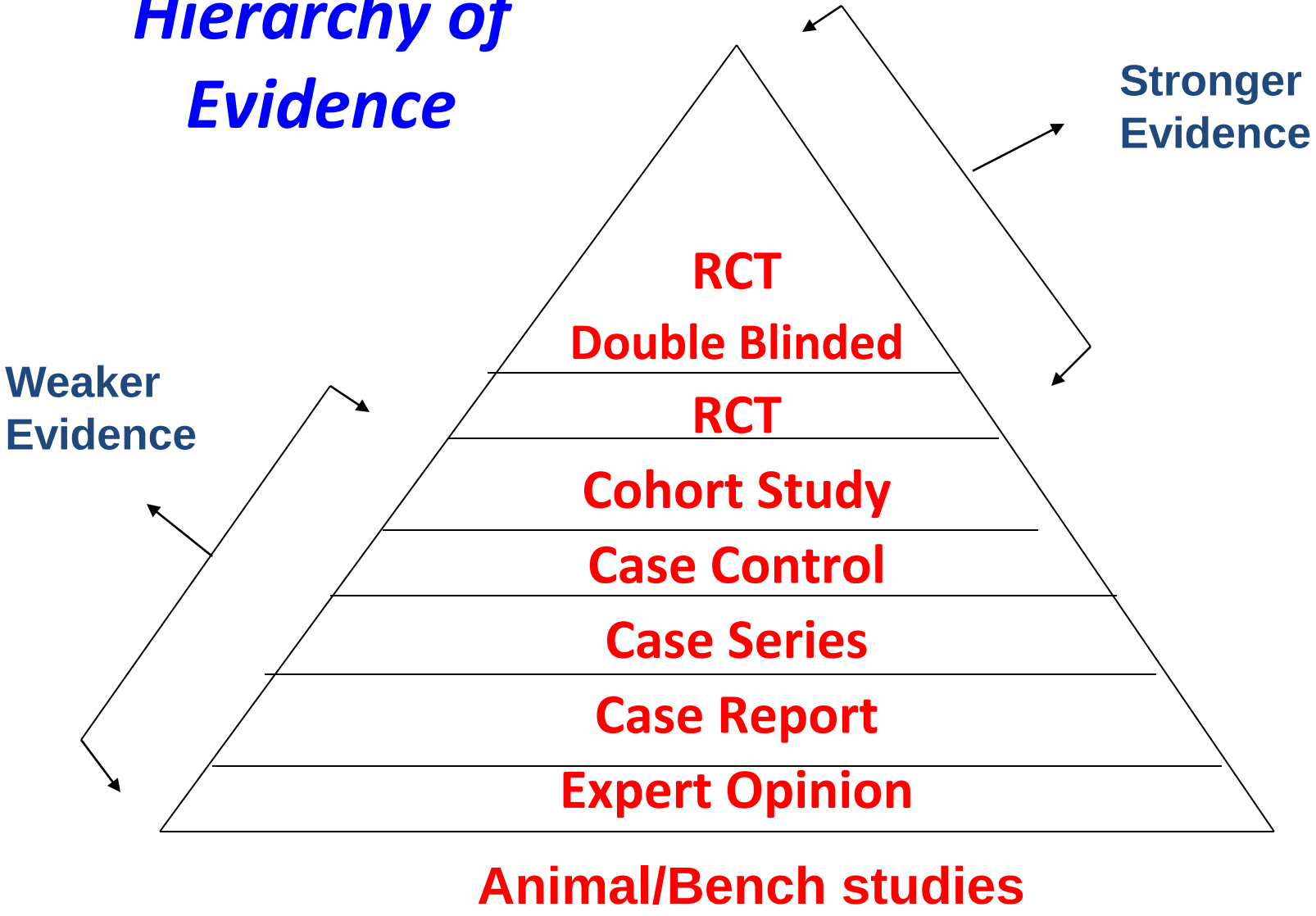


DIETARY GUIDELINES FOOD PATTERNS BASED ON

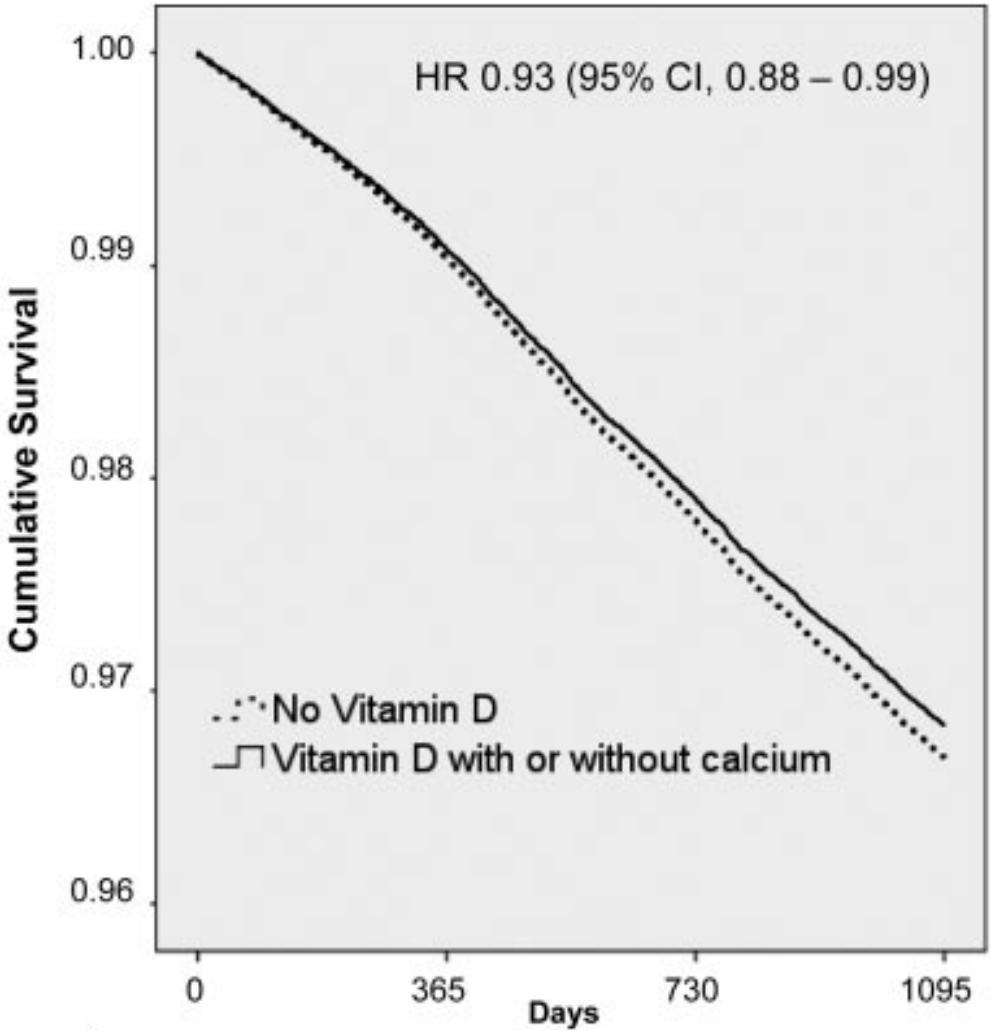
- Food modeling to meet DRIs
- Evidence of relationship of food intake dose to health



Hierarchy of Evidence

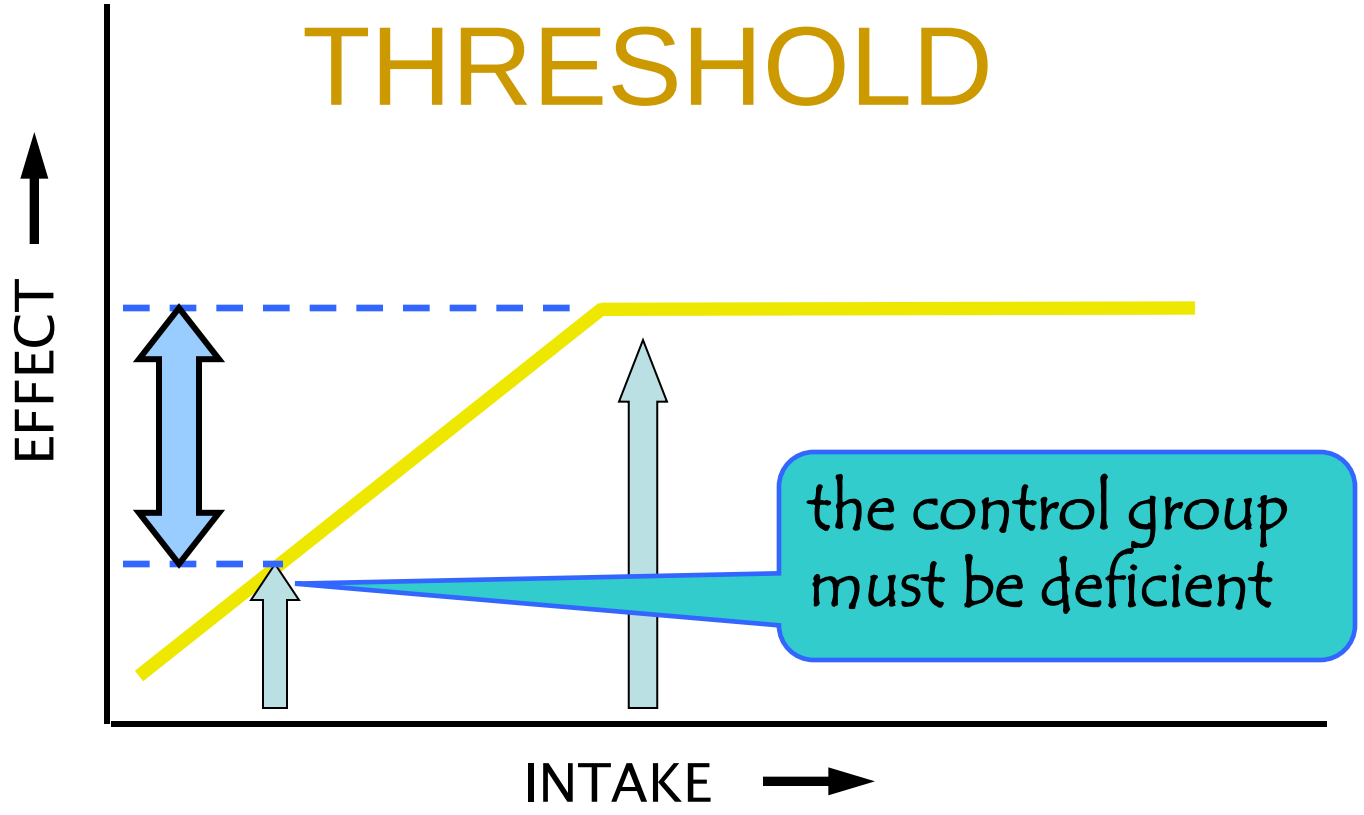


Vitamin D and Ca Supplements Reduced All Cause Mortality by 7% compared to placebo in >70,000 median age 70y



Rejnmark et al., JCEM v97, 2012

STUDY DESIGN & THE THRESHOLD



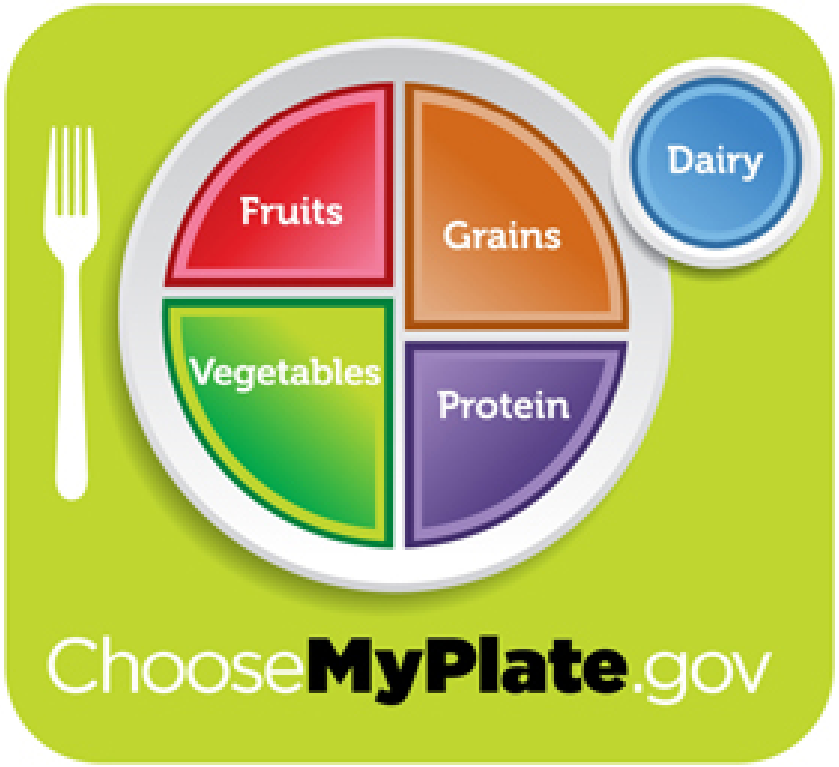
THE ETHICAL PROBLEM

- placing the control group on a clearly inadequate intake

ETHICALLY ACCEPTABLE?

Milk products and health

US 2010 Dietary Guidelines recommend 3 cups milk products per day (871/mg Ca)



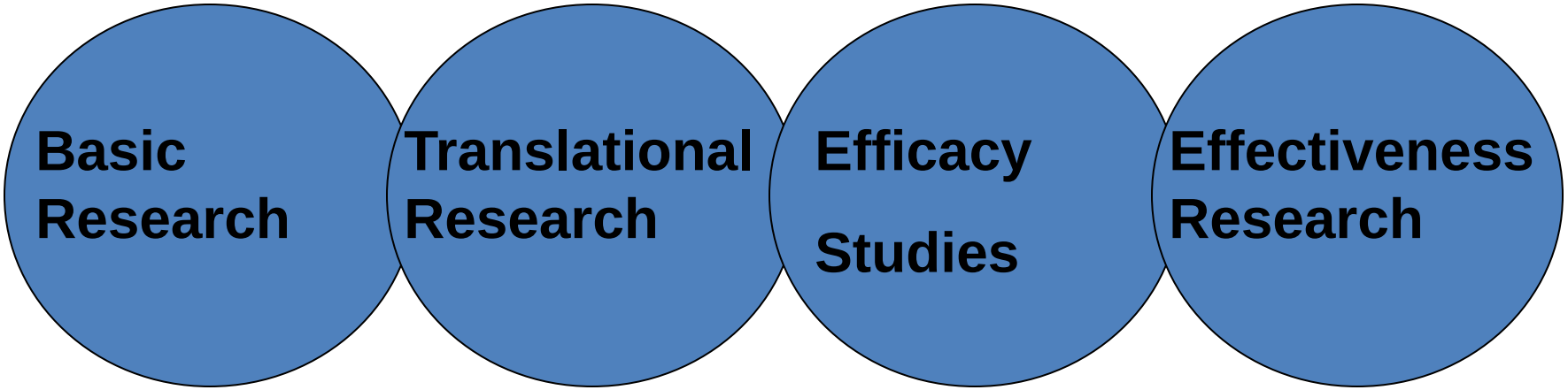
- For every missing dairy product equivalent, take a 300 mg Ca supplement.

Wont' get too much.

http://www.myplate.gov

Many kinds of evidence

How does it work?	Can it be studied in people?	Specific effects?	How good is the translation?



Best recommendations use the totality of evidence with liberal doses of critical thinking and LOGIC!

Future Needs

- Good biomarkers for intake and health outcome measures are critical for understanding the relationship of diet and health.
- RCTs to determine requirements of nutrients/diet based on supplements and populations who are not deficient give incomplete answers.
- Improving healthy diets requires assess to health food – responsibility of everyone.