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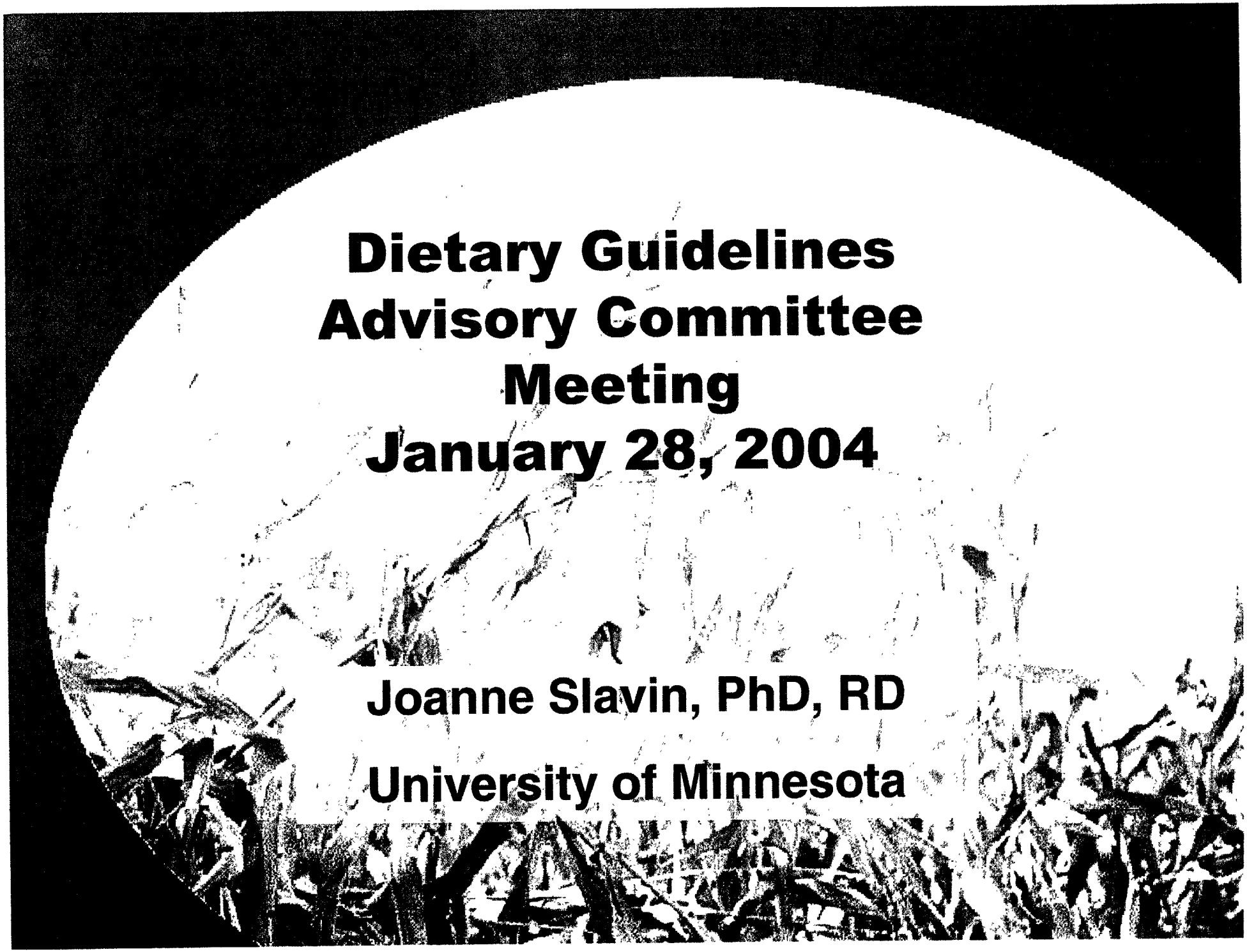


Dietary Guidelines Advisory Committee Meeting January 28, 2004

Joanne Slavin, PhD, RD

University of Minnesota

Dietary approaches to weight control

- **Eat fewer calories and exercise more**
  - Counting calories
  - Counting fat grams
  - Micro-managing the diet
    - Low carbohydrate
    - High protein
    - Diet programs, products, advice

Diet strategies

- Eat less carbohydrate – since major source of calories, any change significant
- Eat less fat – calorie density positives – palatability problems
- Eat more protein – self-limiting, leads to lower calorie intake
- Successful calorie-cutting needs to be acceptable for the long run – can I be on this diet forever?

Eating and exercise targets from National Academies Institute of Medicine

- 45 – 65% of calories from carbohydrate
- 20 – 35% of calories from fat
- 10 – 35 % of calories from protein
- Spend a total of at least one hour each day in moderately intense physical activity – double the daily goal set by the 1996 Surgeon General's report

How does a high CHO/low fat diet compare to a high fat/low CHO diet for weight maintenance

- Case-control studies of the dietary composition in obese and non-obese subjects find a pattern of low carbohydrate intake in the obese
- Inverse relationship between carbohydrate and BMI in 8 of 9 studies
- Positive association between percentage fat and BMI
- Form of carbohydrate requires further study
- Saris. Nutr Rev 2003;61:S10.

How does a high CHO/low fat diet compare to a high fat/low CHO diet for weight loss

- Low fat diets are the optimal choice for the prevention of weight gain and obesity (Astrup et al; Proc Nutr Soc 2002;61:299)
- Low carbohydrate (Atkins) diet more effective at weight loss at 3 and 6 months – no difference at 12 months (Foster et al; NEJM 2003;348:2082)
- Overweight subjects consuming low-fat, high CHO diets eat fewer calories, lose weight and lose body fat (A) (Freedman & Kennedy; Obesity Res 2001;9(Suppl 1):1S)

National Weight Control Registry

- Lost at least 30 pounds and maintained the loss for at least 1 year
- Eating a low-fat, high-carbohydrate diet: 24% fat, 56% CHO, 19% protein
- Eating breakfast
- Monitoring food intake and body weight
- Maintaining high levels of physical activity
- Wyatt et al, Obesity Res 2002;10:78

Evaluating diet

- Diet is a complex exposure – we all eat everyday, it can vary greatly, and it is difficult to evaluate
- Have taken the reductionist approach to diet – look at calories, macronutrients, micronutrients,
- Current interest more in dietary patterns, intake of whole foods, eating timing and frequency

Food Sources and Dietary Correlates

- Only in controlled feeding studies can you hold fat intake constant and vary fiber intake
- Consumption of plant foods, fruits, vegetables, and breakfast cereals is associated with low fat intake
- Low fat consumers have higher intakes of dietary fiber, water soluble vitamins, and minerals
- Fat soluble vitamins are associated with fat intake
- (Mattisson et al; Pub Health Nutr 2003;6:559)

Setting recommendations for macronutrients

- Need to set your base with protein intake (10-35% of kcalories)
- Include enough fat to get essential fatty acids, fat soluble vitamins, minerals, and fat soluble phytochemicals (20-35% of kcalories)
- Include enough carbohydrates to RDA (130 g/d), dietary fiber (25-38 g/day), vitamins, minerals, and phytochemicals (45-65% of kcalories)

Does a carbohydrate equal a carbohydrate - No

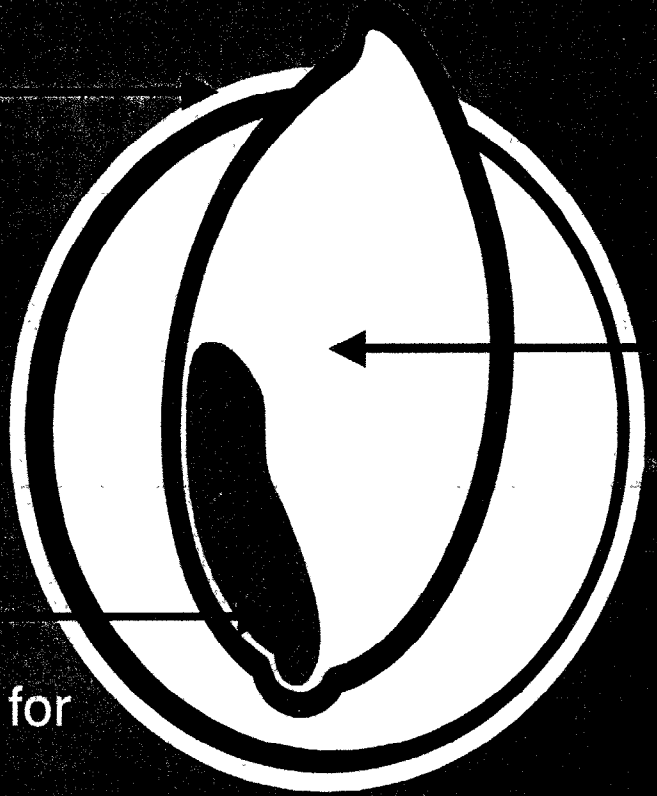
- Chemical structure – mono, di, polysaccharide
- Digestible vs. non-digestible
- Speed of digestion and absorption – Glycemic index
- Fermentable vs. non-fermentable
- Physical structure – in solution, part of a food, associated substances (protein), part of a seed or grain, particle size

What is a Whole Grain?

Bran

"Outer shell" protects seed

- Fiber
- B Vitamins
- Trace Minerals



Germ

Nourishment for the seed

- B Vitamins
- Vitamin E
- Trace Minerals
- Phytochemicals

Endosperm

Provides energy

- Carbohydrate
- Protein
- Some B Vitamins

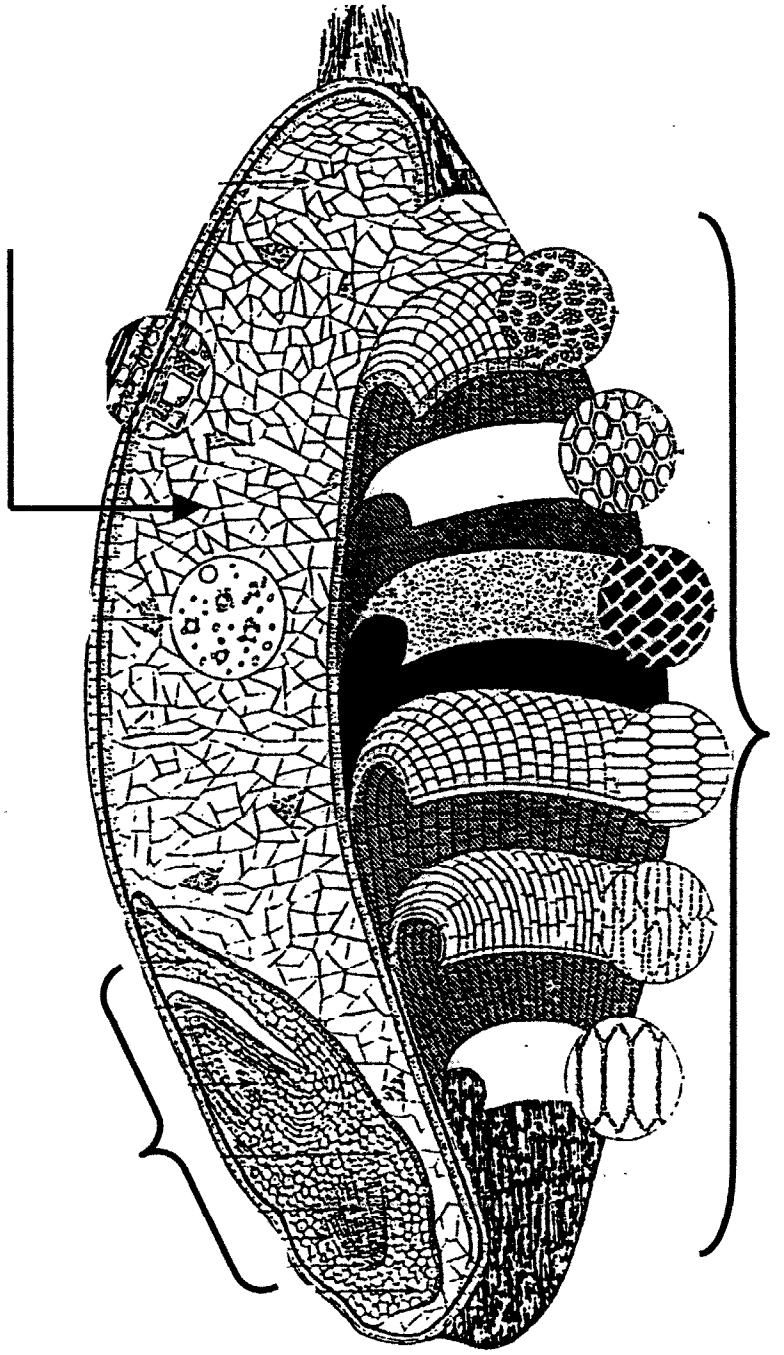
Grain Refining

Milling

Removal of bran and germ layers.

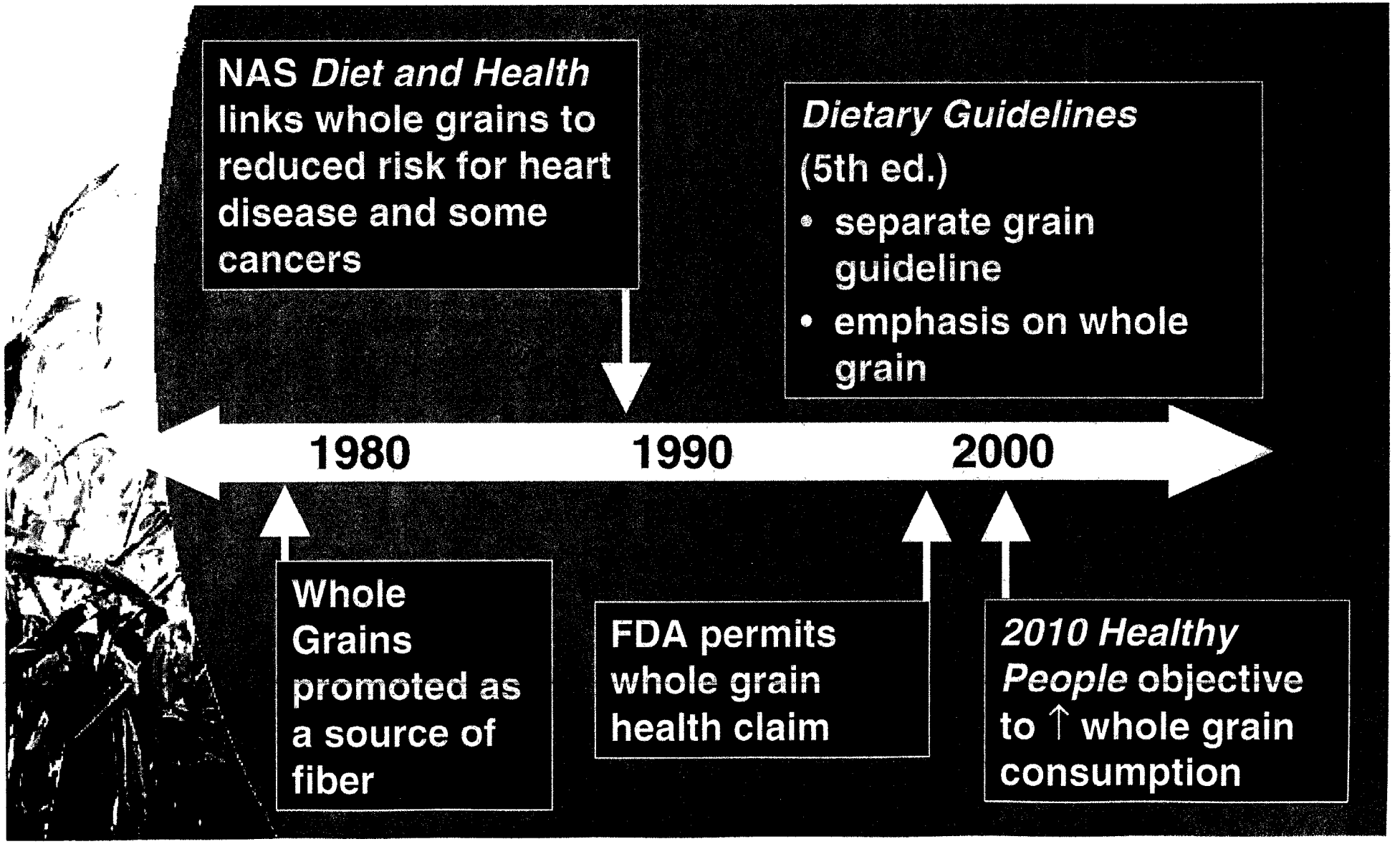
Nutrients lost:

- Vitamins
- Minerals
- Phenolics
- Fiber



Enhance desirability.
Improve texture, flavor, appearance.
Increase shelf life.

Whole Grains: Evolution of Dietary Guidance



The Whole Grain Consumption Gap

Recommendations

- The 2000 Dietary Guidelines recommend "several servings of whole grains"
- Healthy People 2010 objectives aim for 3 servings/day
- U.S.Dept of Agriculture and The American Dietetic Association promote "Three are Key"

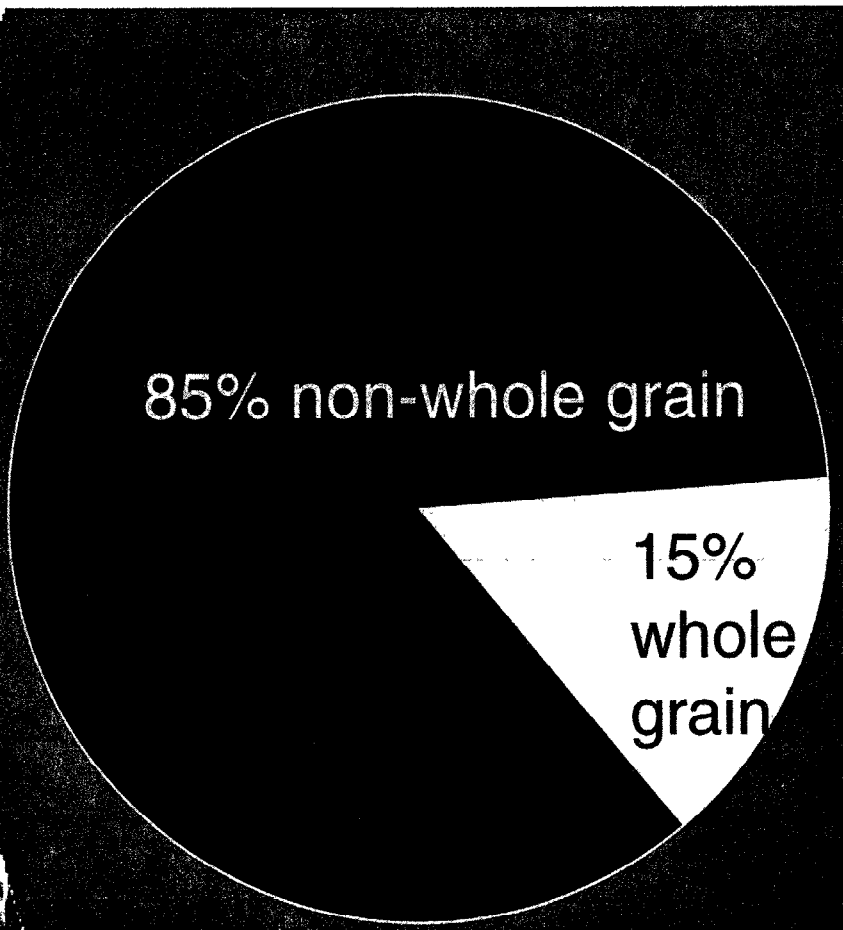
Less than **10%** of Americans are currently meeting this recommendation (USDA)

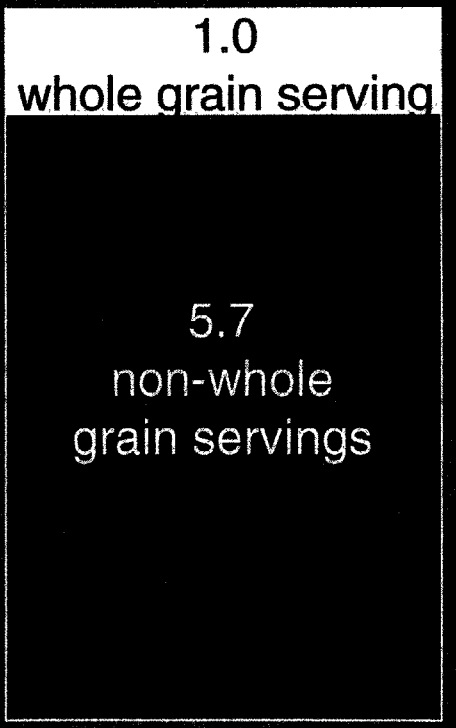
Average whole grain intake is less than 1 serving/day (Albertson et al., 1995)

Whole grain intake in US children and adolescents

- CSFII (1994-1996)
- Average whole grain intake ranged from 0.8 servings per day for preschool children to 1.0 servings per day for adolescents
- Ready-to eat cereals, corn and other chips, and yeast breads were major food sources of whole grains
- Harnack et al. J Am Diet Assoc 2003;103:1015.

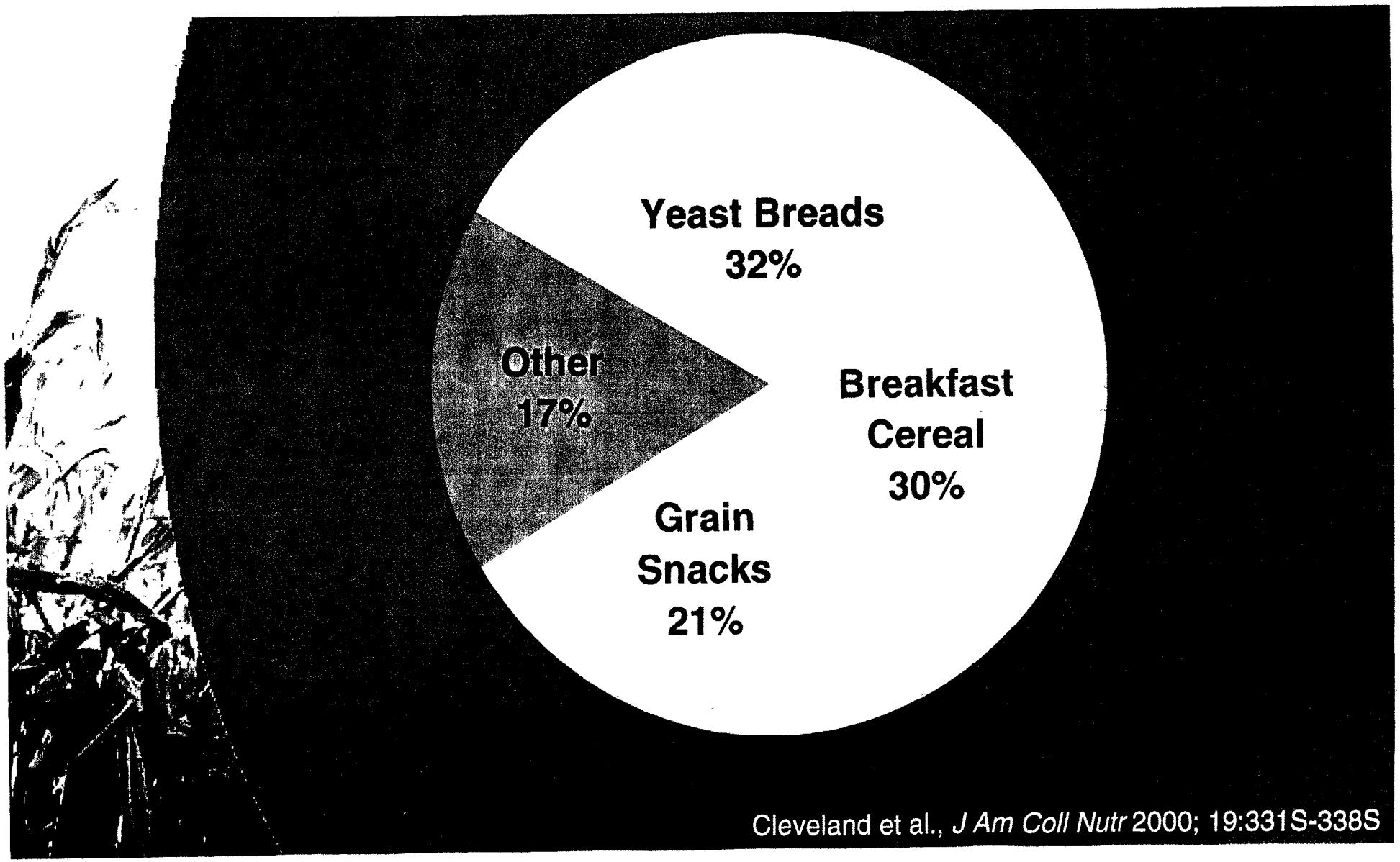
Grain Consumption





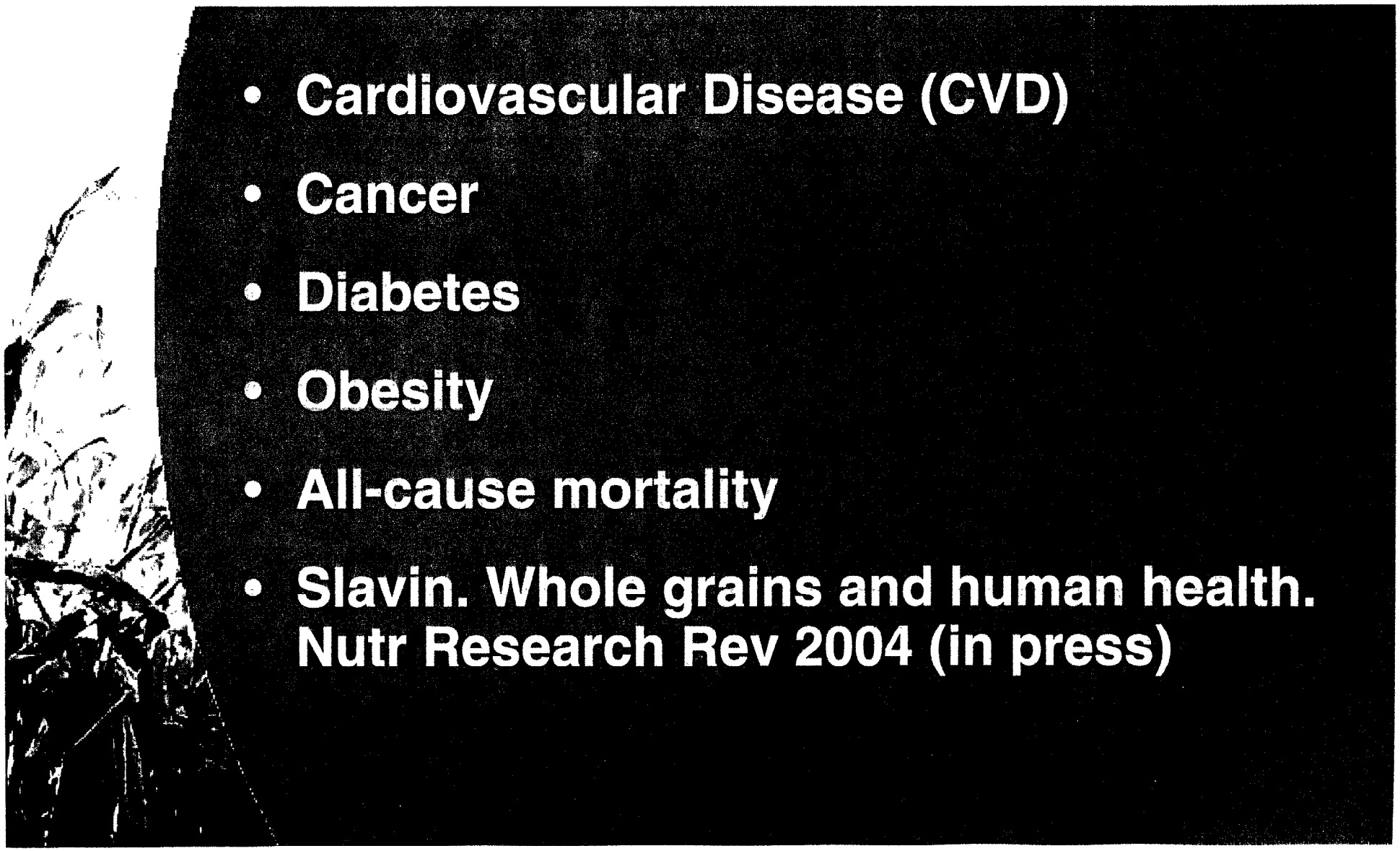
Cleveland et al., *J Am Coll Nutr* 2000; 19:331S-338S

Whole Grain Foods



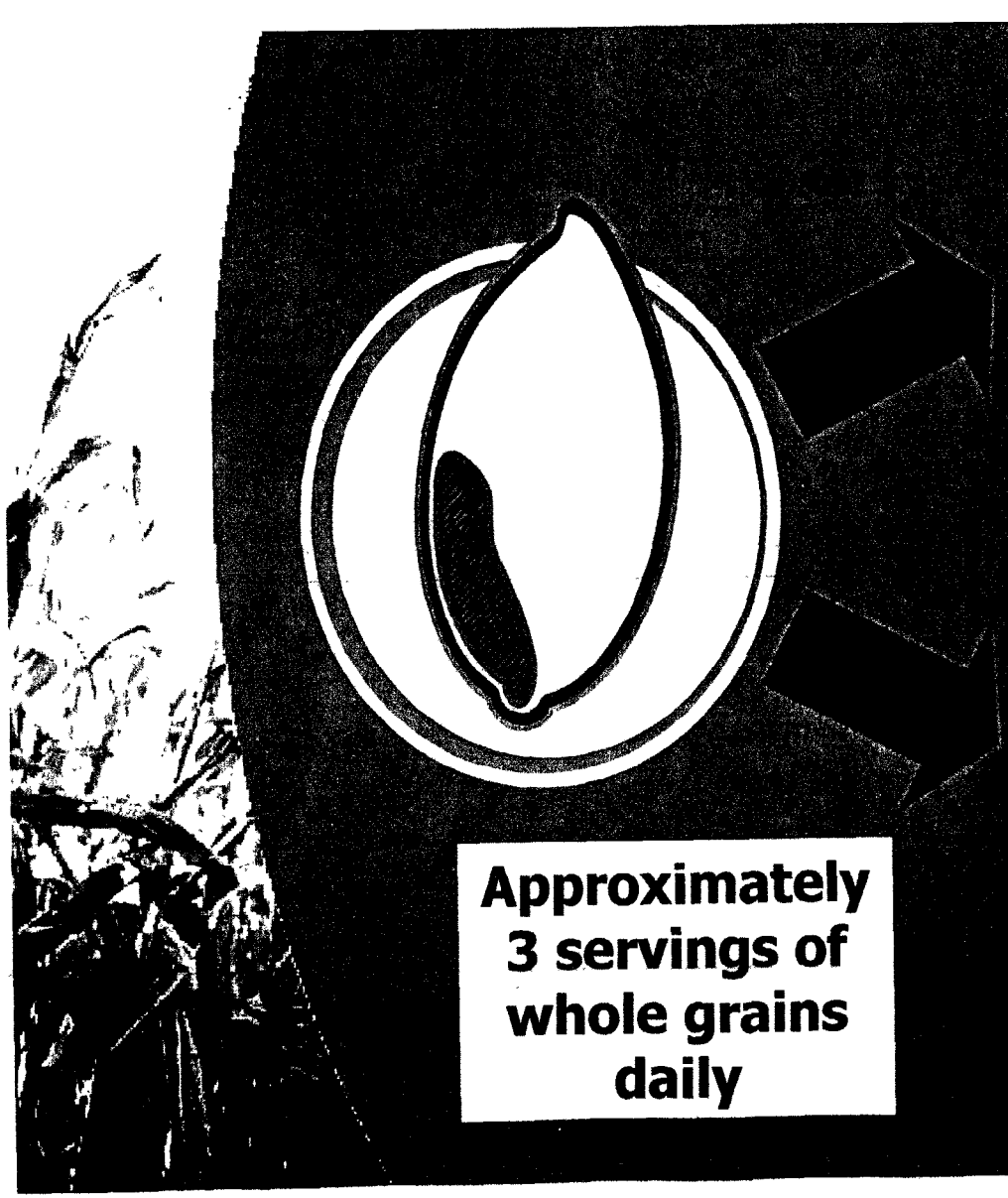
Cleveland et al., *J Am Coll Nutr* 2000; 19:331S-338S

The Link to Chronic Disease



- Cardiovascular Disease (CVD)
- Cancer
- Diabetes
- Obesity
- All-cause mortality
- Slavin. Whole grains and human health. Nutr Research Rev 2004 (in press)

Whole Grains & Type 2 Diabetes: Epidemiological Studies



Data from the Iowa Women's Health Study

21% risk reduction

Data from the Nurses' Health Study

27% risk reduction

Approximately 3 servings of whole grains daily

Meyer, et al., *AJCN*, Apr. 2000

Liu, et al., *AJPH*, Sept. 2000

Insulin Resistance Atherosclerosis Study (IRAS)

- Evaluated link between whole grain consumption and insulin resistance
- Average whole grain consumption 0.8 servings/day
- Whole grain intake was significantly associated with insulin sensitivity
- Liese et al. Am J Clin Nutr 2003;78:965.

Whole grains and insulin sensitivity

- Overweight subjects (11) were fed and whole and refined grain diets for 6 weeks
- Fasting insulin was 10% lower during consumption of whole grain diet
- Tendency for improvements in insulin sensitivity with whole grain diet
- Pereira et al, Am J Clin Nutr, 2002, 75:848-855

Whole Grains & Obesity: Epidemiological Studies

- Framingham offspring
- Whole grain intake inversely associated:

	Lowest Whole Grain Intake	Highest Whole Grain Intake	P for trend
Waist Hip Ratio	0.92	0.91	0.005

McKeown et al., Am J Clin Nutr 2002; 76(2):390-8

Whole Grains & Obesity: Epidemiological Studies

- Nurses Health Study
- Women who consumed more whole grains consistently weighed less than women who consumed less whole grains
- Women in the highest quintile of dietary fiber intake had a 49% lower risk of major weight gain
- Refined grain intake was linked to increased risk of weight gain
- Liu et al, Am J Clin Nutr 2003;78:920

Whole Grain Foods and Markers of Bowel Health in Overweight Men

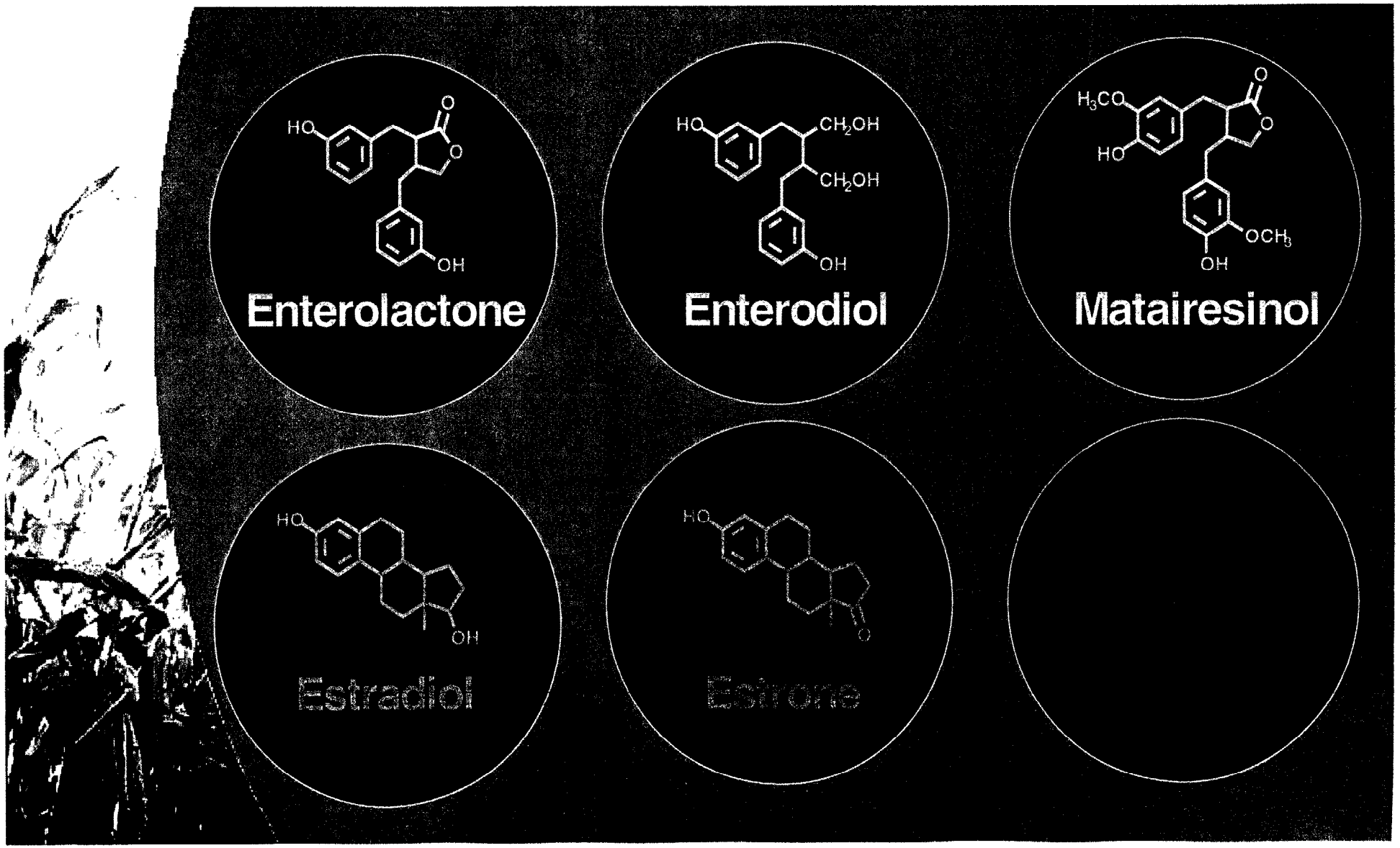
- 28 men
- Consumed diets (total dietary fiber = 32 grams/day)
- High fiber diet with either:
  - Whole wheat
  - Whole rye

- Significant increase in stool weight
- Reduced fecal ß-glucuronidase
- Reduced postprandial plasma glucose and insulin
- Rye foods increased plasma enterolactone and fecal butyrate

Whole grain diets improve markers of bowel health

McIntosh Am J Clin Nutr 2003;77:967-74

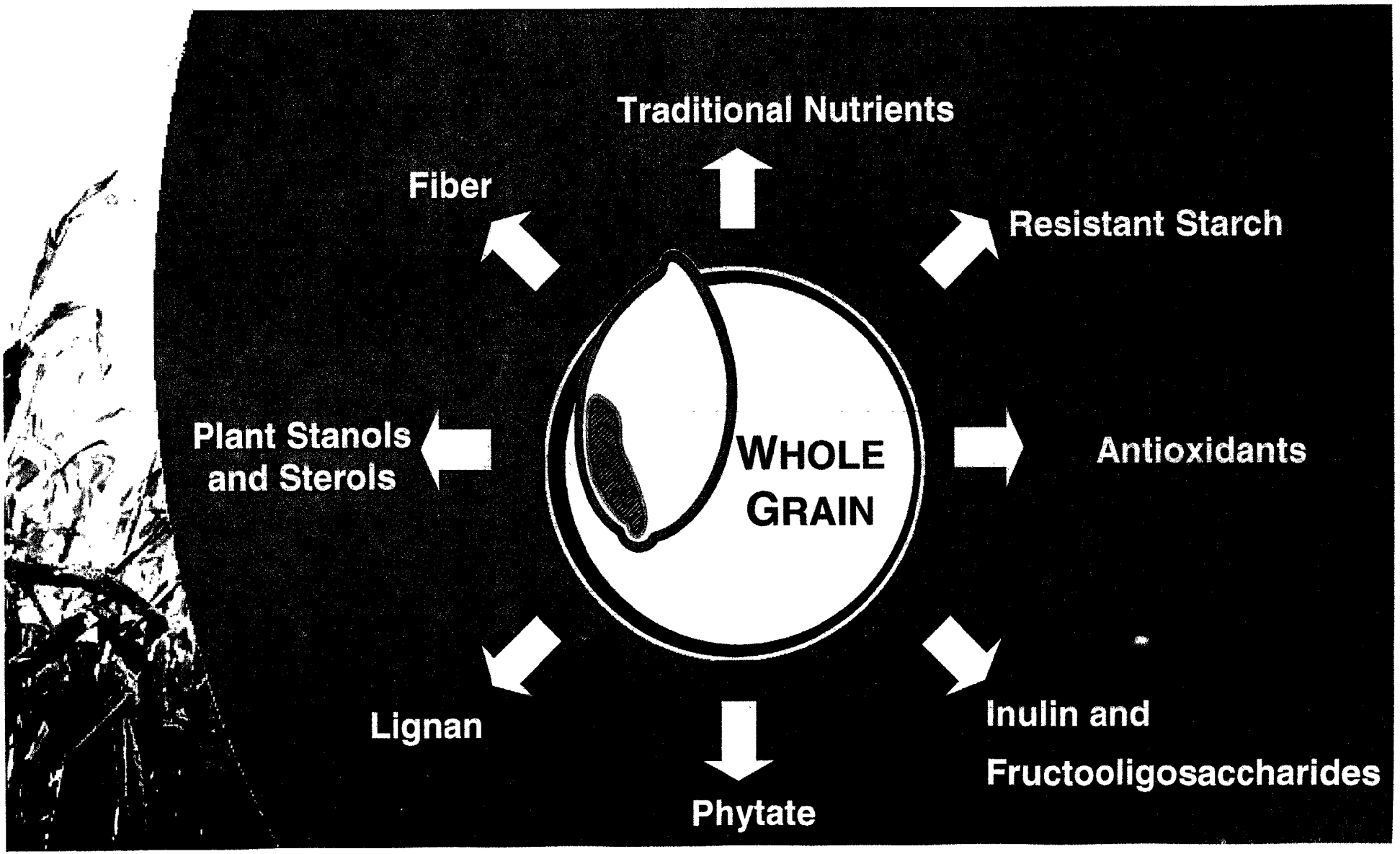
Lignans and Estrogens



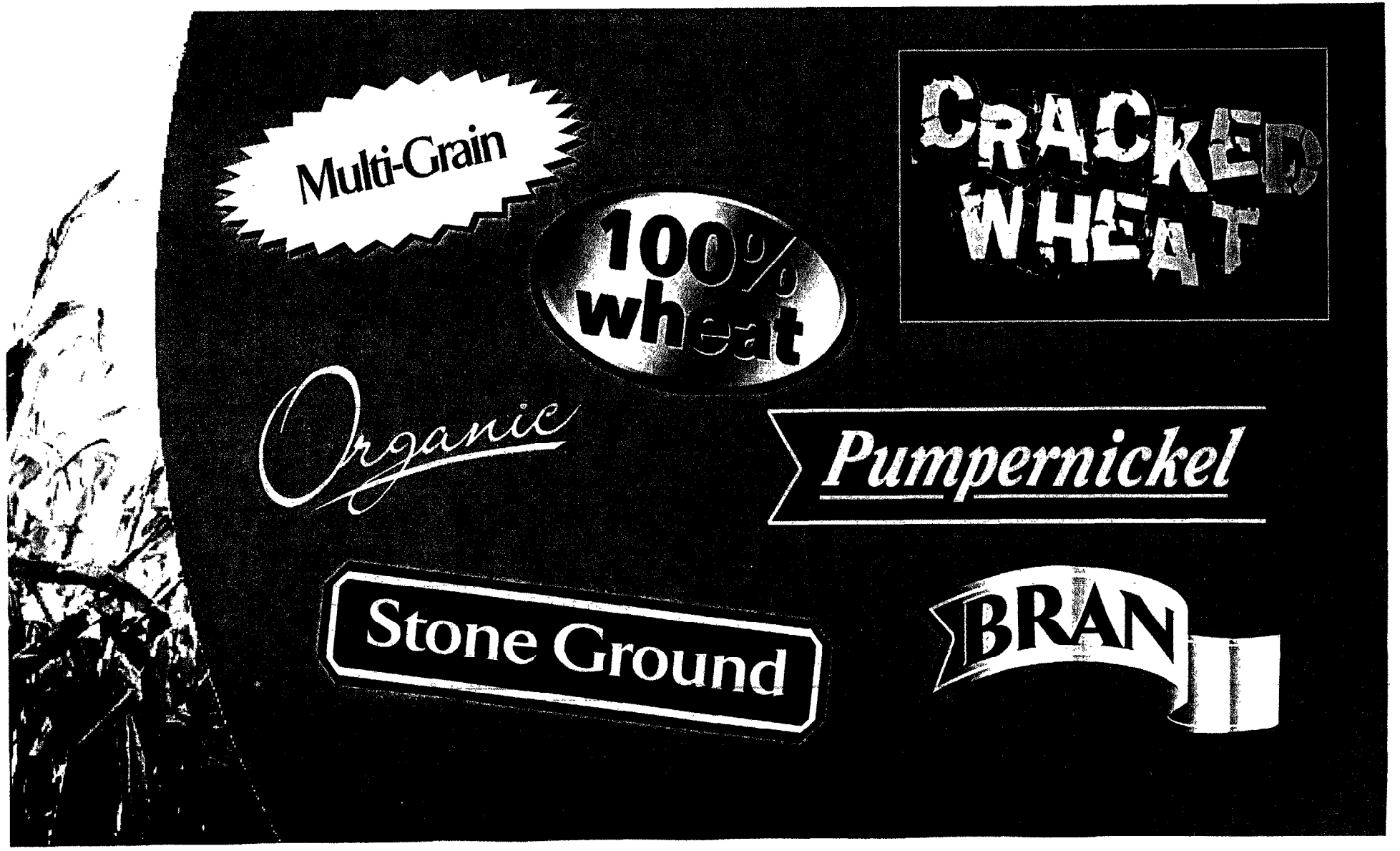
Serum Enterolactone and CHD and CVD Risk

- High serum enterolactone level is associated with:
  - Reduced CHD and CVD related mortality in middle-aged Finnish men (Vanharanta et al; Arch Intern Med 2003;163:1099-1104)
- Whole grain food intake elevates serum enterolactone (Jacobs et al; 2003;Br J Nutr 88:111-116)

Whole Grain Components

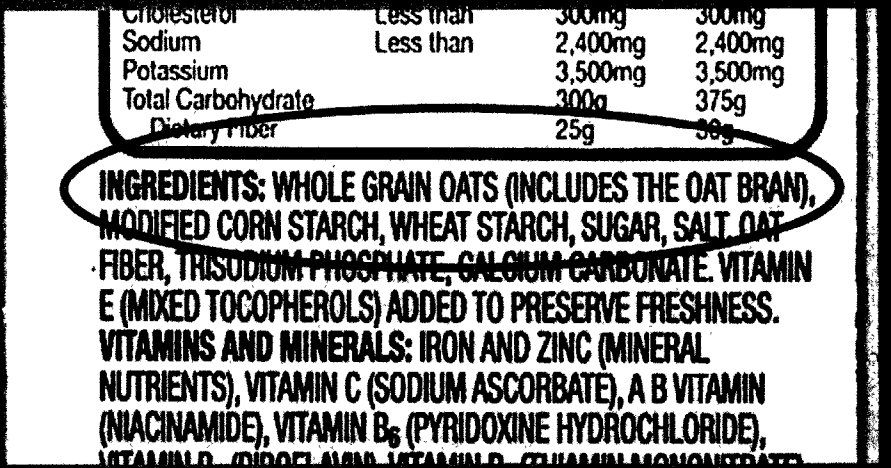


Will the Whole Grain Please Stand Up?



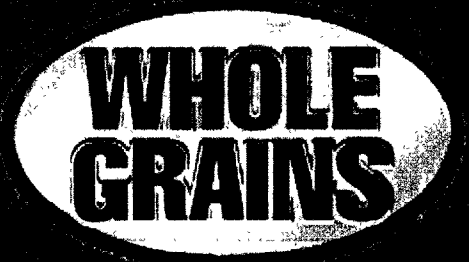
Finding Whole Grain Foods

- Choose foods with the whole grain ingredient listed first
  - whole wheat flour
  - whole oats
  - whole grain corn
  - brown rice
- Look for a whole grain seal or whole grain health claim on a package

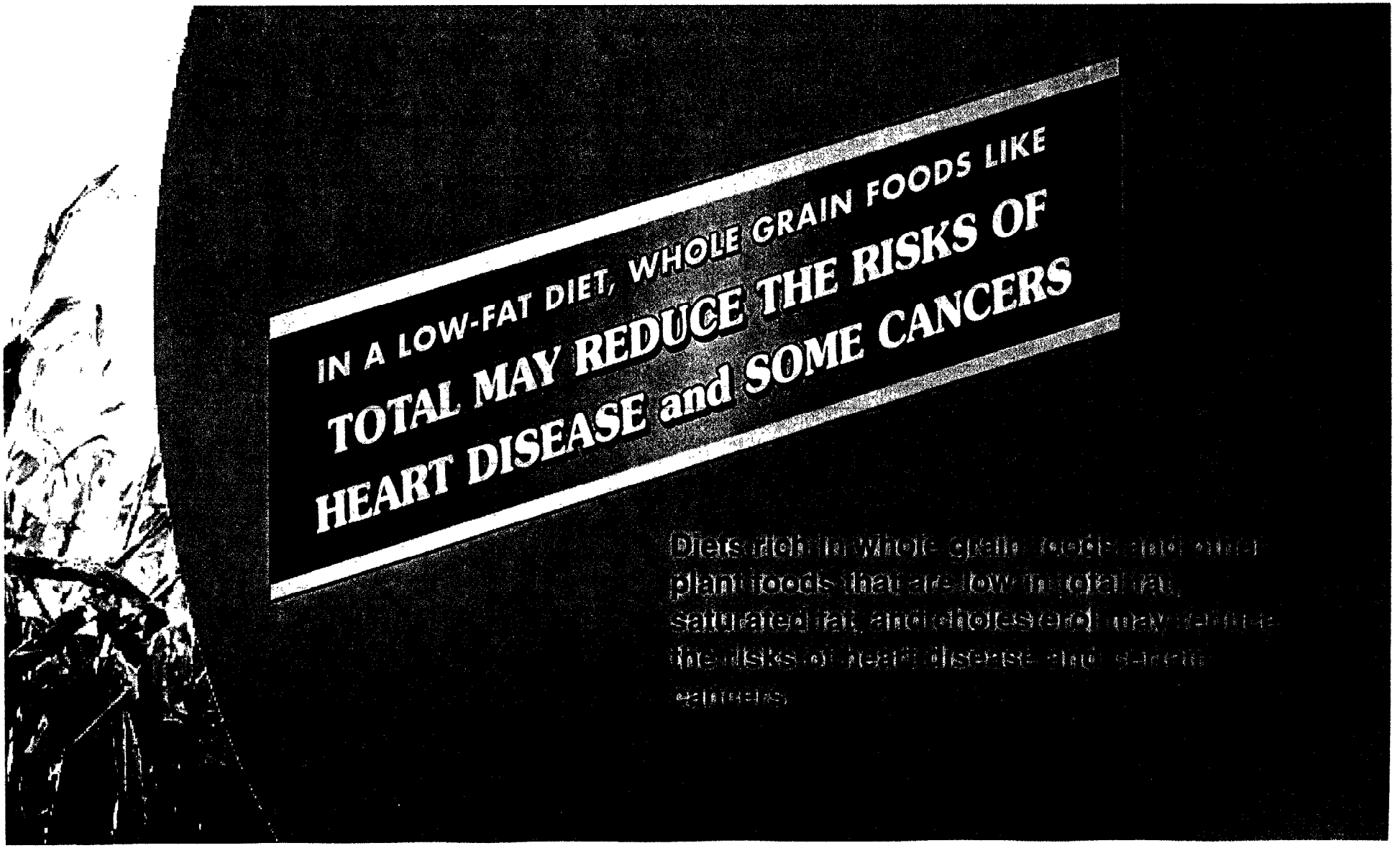


Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Potassium		3,500mg	3,500mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

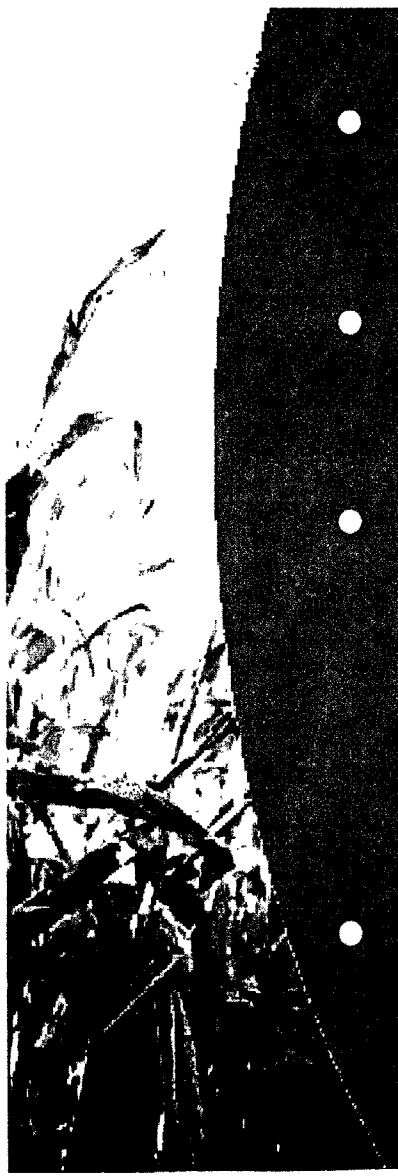
INGREDIENTS: WHOLE GRAIN OATS (INCLUDES THE OAT BRAN), MODIFIED CORN STARCH, WHEAT STARCH, SUGAR, SALT, OAT FIBER, TRISODIUM PHOSPHATE, CALCIUM CARBONATE. VITAMIN E (MIXED TOCOPHEROLS) ADDED TO PRESERVE FRESHNESS. **VITAMINS AND MINERALS:** IRON AND ZINC (MINERAL NUTRIENTS), VITAMIN C (SODIUM ASCORBATE), A B VITAMIN (NIACINAMIDE), VITAMIN B_6 (PYRIDOXINE HYDROCHLORIDE),



Look for the Health Claim



Break Down Myths: Know the Facts



- **Processed foods (cereals, crackers) can still be whole grain**
- **Cereals made from whole grains are convenient and low in fat**
- **Color is not a good indication of whole grain**
  - Some whole grain foods are not brown
  - Brown coloring may come from molasses and other ingredients
- **Whole grains provide a "nutty" flavor and texture to foods**

Whole Grain Benefits: Fiber

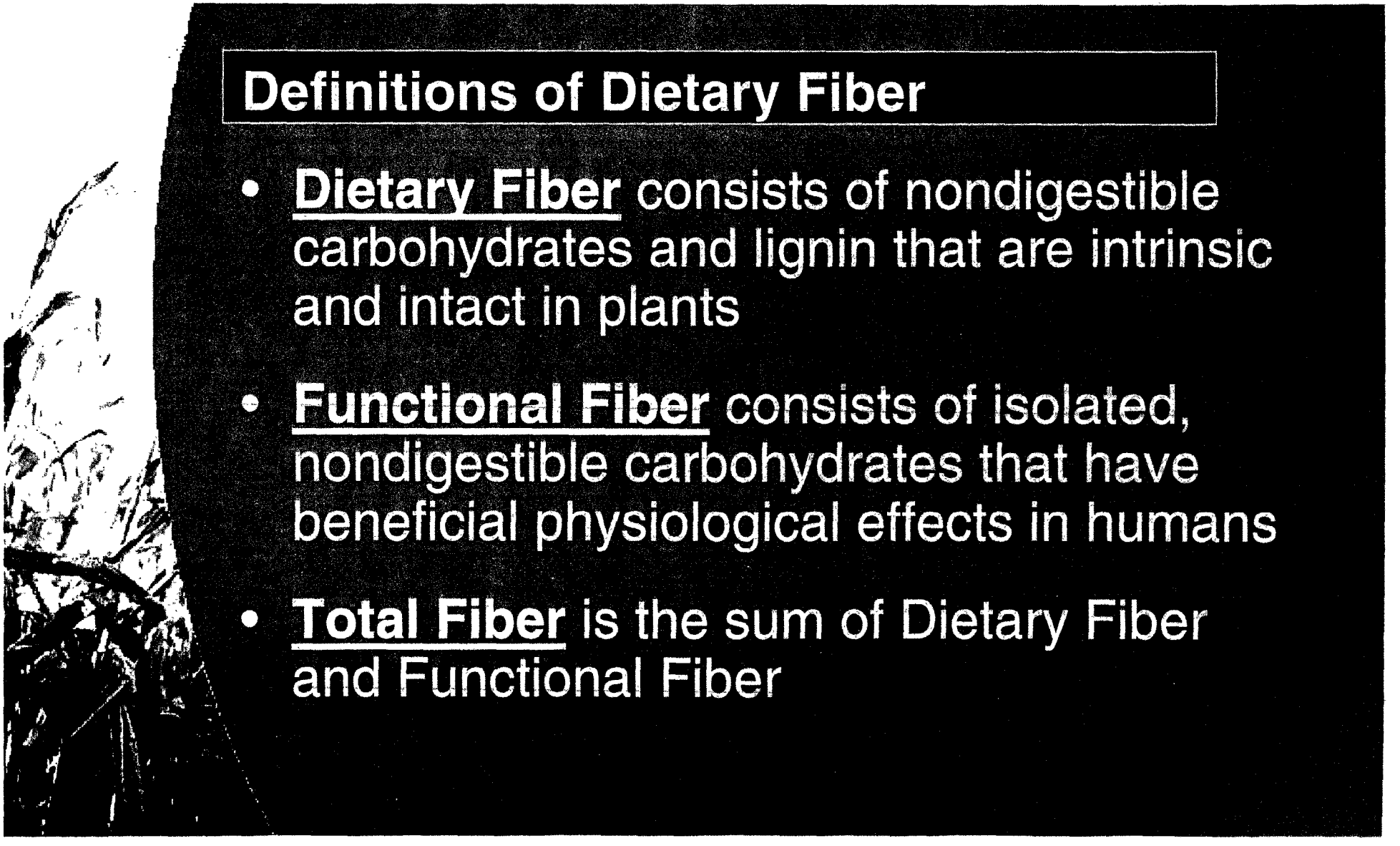
Fiber Recommendations

- National Academy of Sciences Institute of Medicine recommendations on fiber

	< 50 years old	> 50 years old
Men	38 grams/day	30 grams/day

- Current fiber intake = 12 – 15 grams/day

Dietary Fiber Defined



Definitions of Dietary Fiber

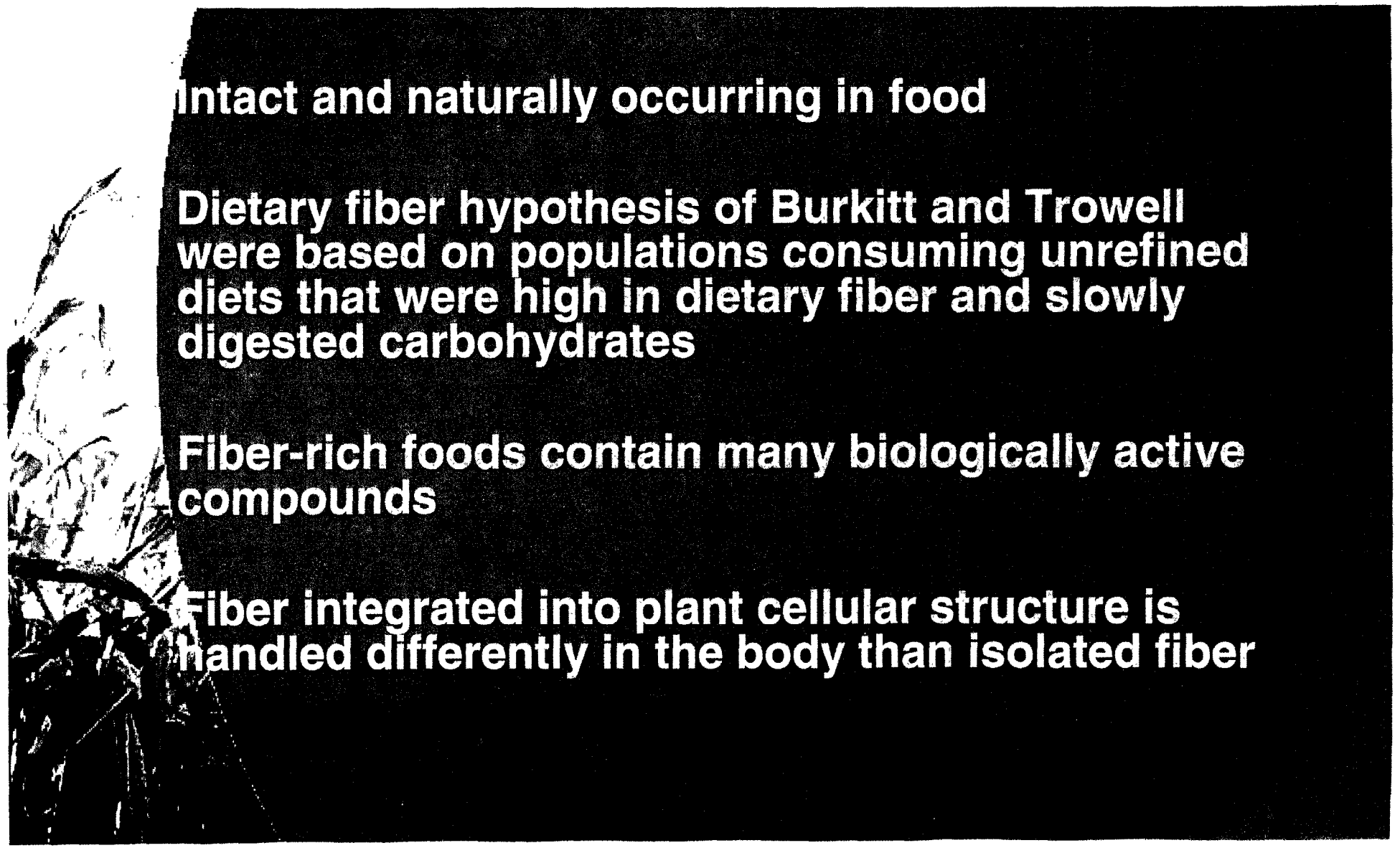
- **Dietary Fiber** consists of nondigestible carbohydrates and lignin that are intrinsic and intact in plants
- **Functional Fiber** consists of isolated, nondigestible carbohydrates that have beneficial physiological effects in humans
- **Total Fiber** is the sum of Dietary Fiber and Functional Fiber

DRIs for dietary, functional, and total fiber

- An Adequate Intake (AI) for Total Fiber in foods is set at 38 and 25 g/day for young men and women, respectively, based on the intake level observed to protect against coronary heart disease

- There is insufficient evidence to set a Tolerable Upper Intake Level for Dietary Fiber or Functional Fibers

Issues in defining dietary fiber



Intact and naturally occurring in food

Dietary fiber hypothesis of Burkitt and Trowell were based on populations consuming unrefined diets that were high in dietary fiber and slowly digested carbohydrates

Fiber-rich foods contain many biologically active compounds

Fiber integrated into plant cellular structure is handled differently in the body than isolated fiber

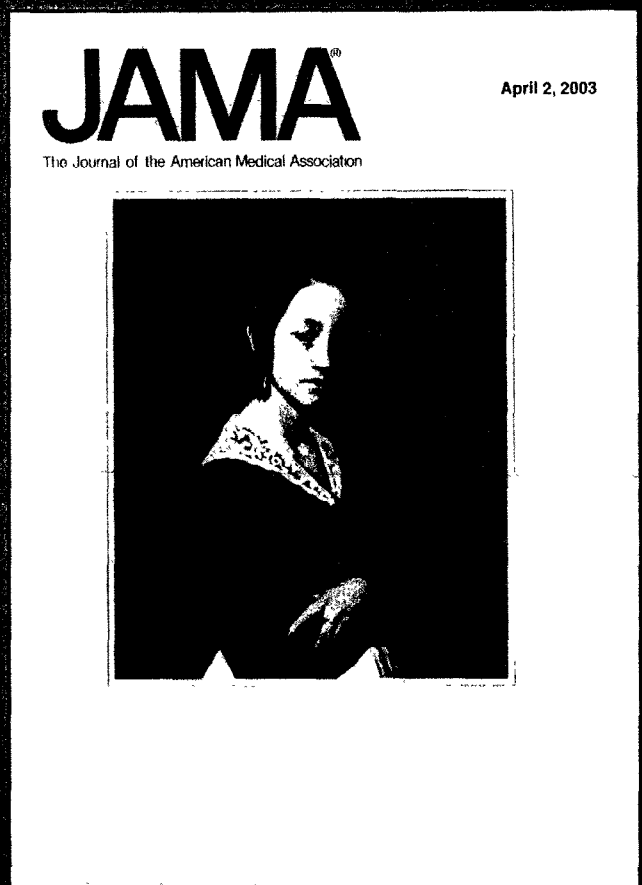
Cardiovascular health study

Cereal, fruit and vegetable fiber intake and the risk of CVD in elderly individuals

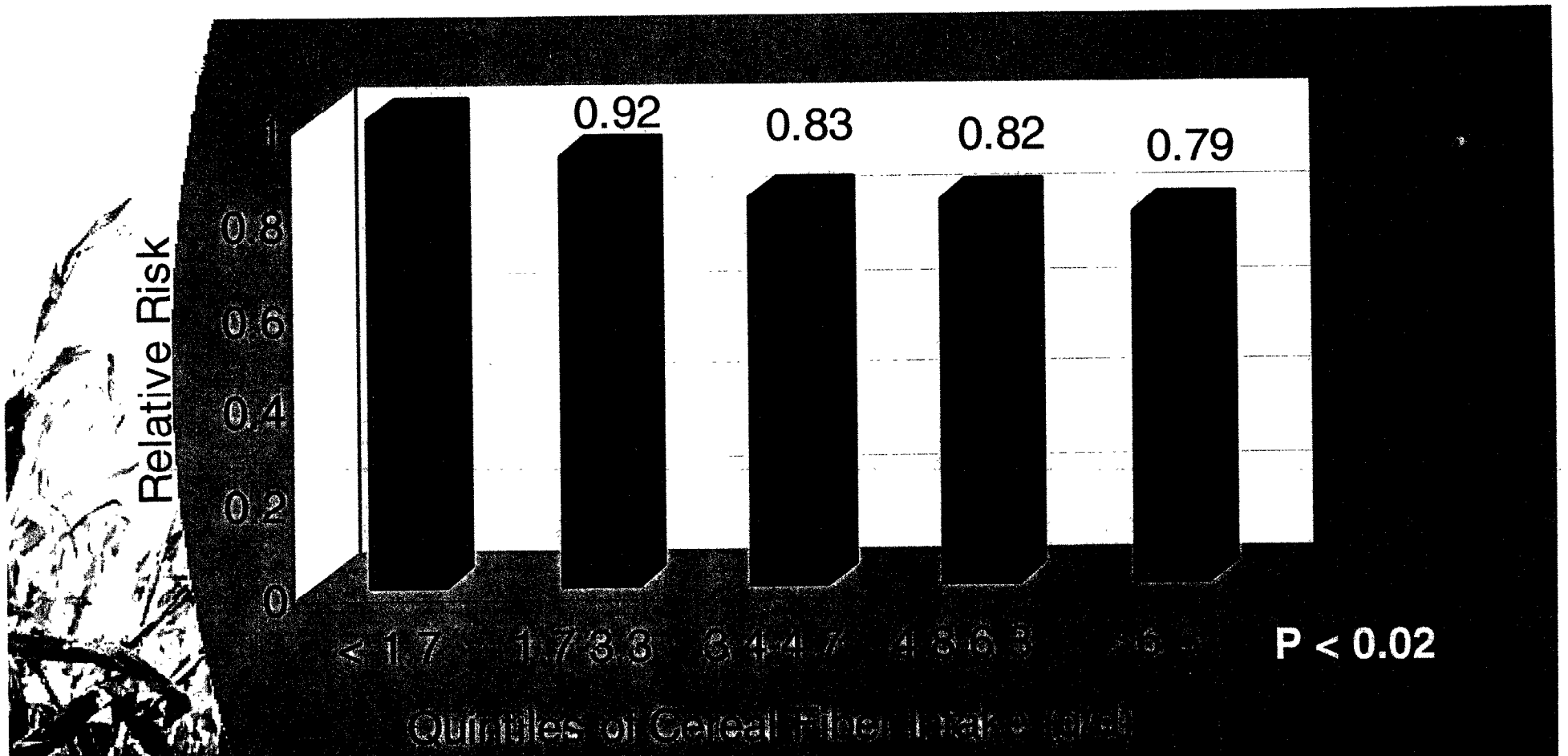
3588 elderly subjects, prospective study

Cereal fiber consumption late in life is associated with lower risk of incident CVD, supporting recommendations to increase dietary fiber

Mozaffarian et al. JAMA 2003;289:1659



Risk of Cardiovascular Disease According to Cereal Fiber Consumption



* Adjusted for age, sex, education, diabetes, ever smoking, pack years of smoking, daily physical activity, exercise intensity, alcohol intake, and cereal, fruit, and vegetable fiber intake.

Source: Mozaffarian et al. 2003 JAMA 289:1659-1666.

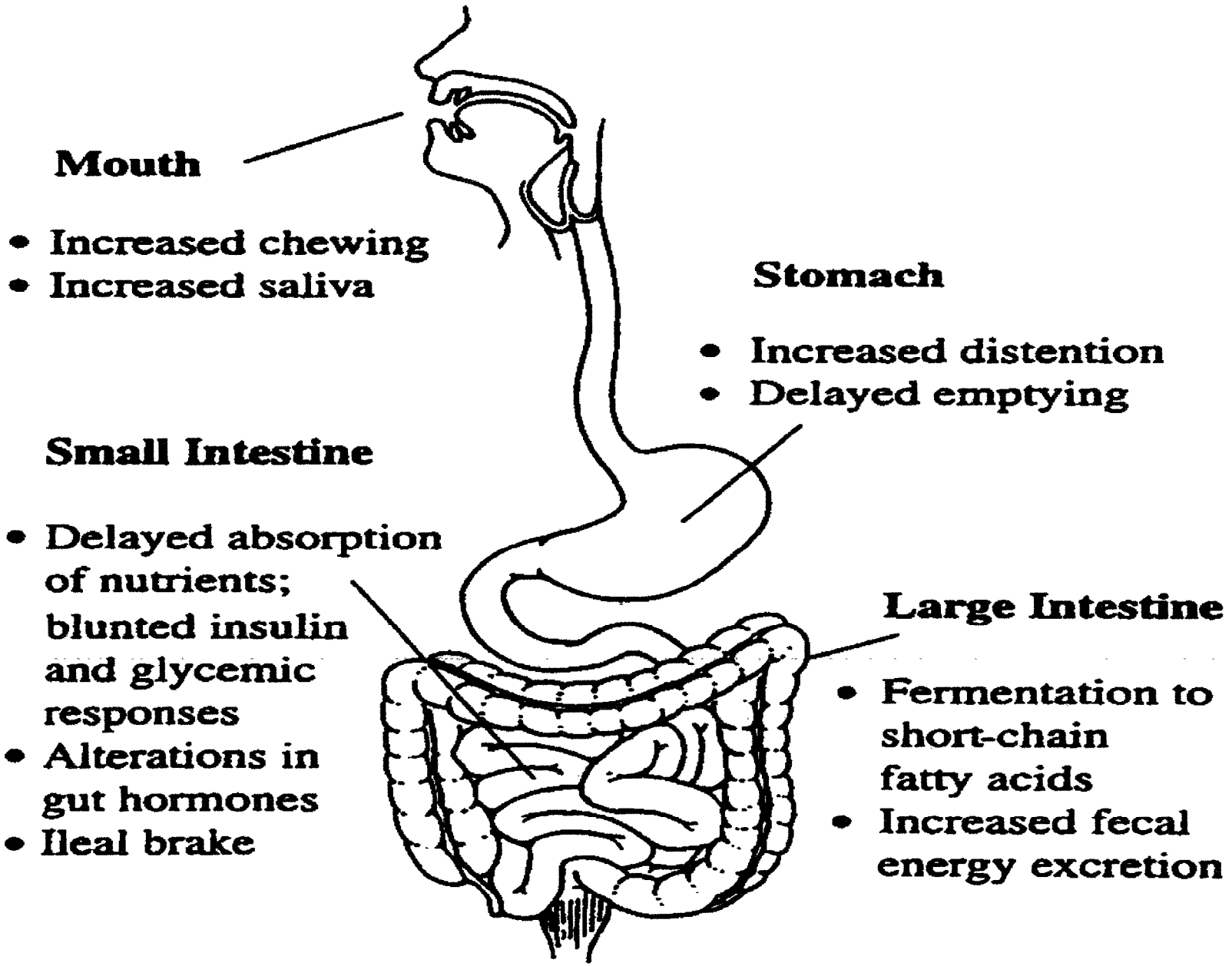
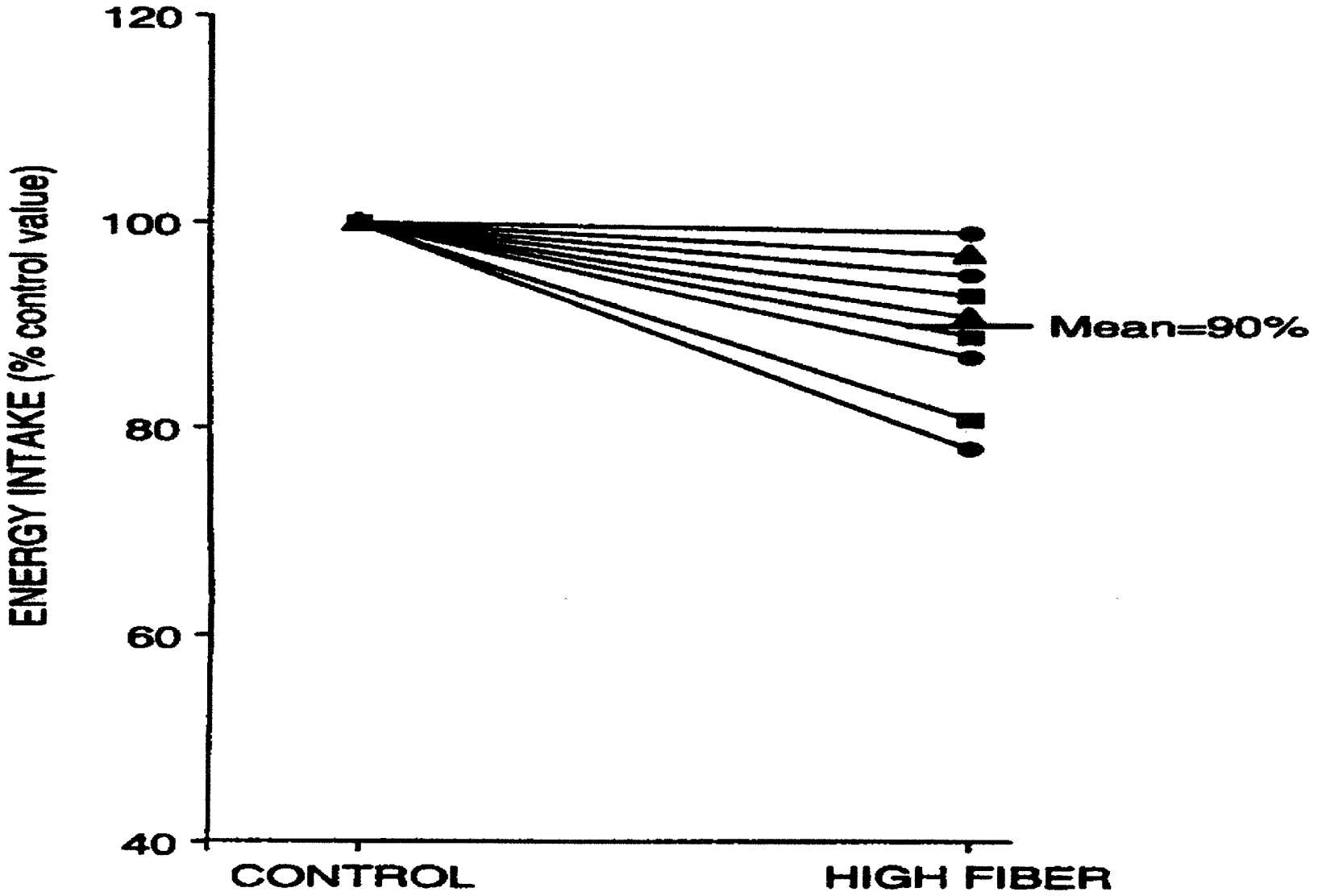


Figure 1. The effects of fiber in the gastrointestinal tract on parameters related to energy regulation.

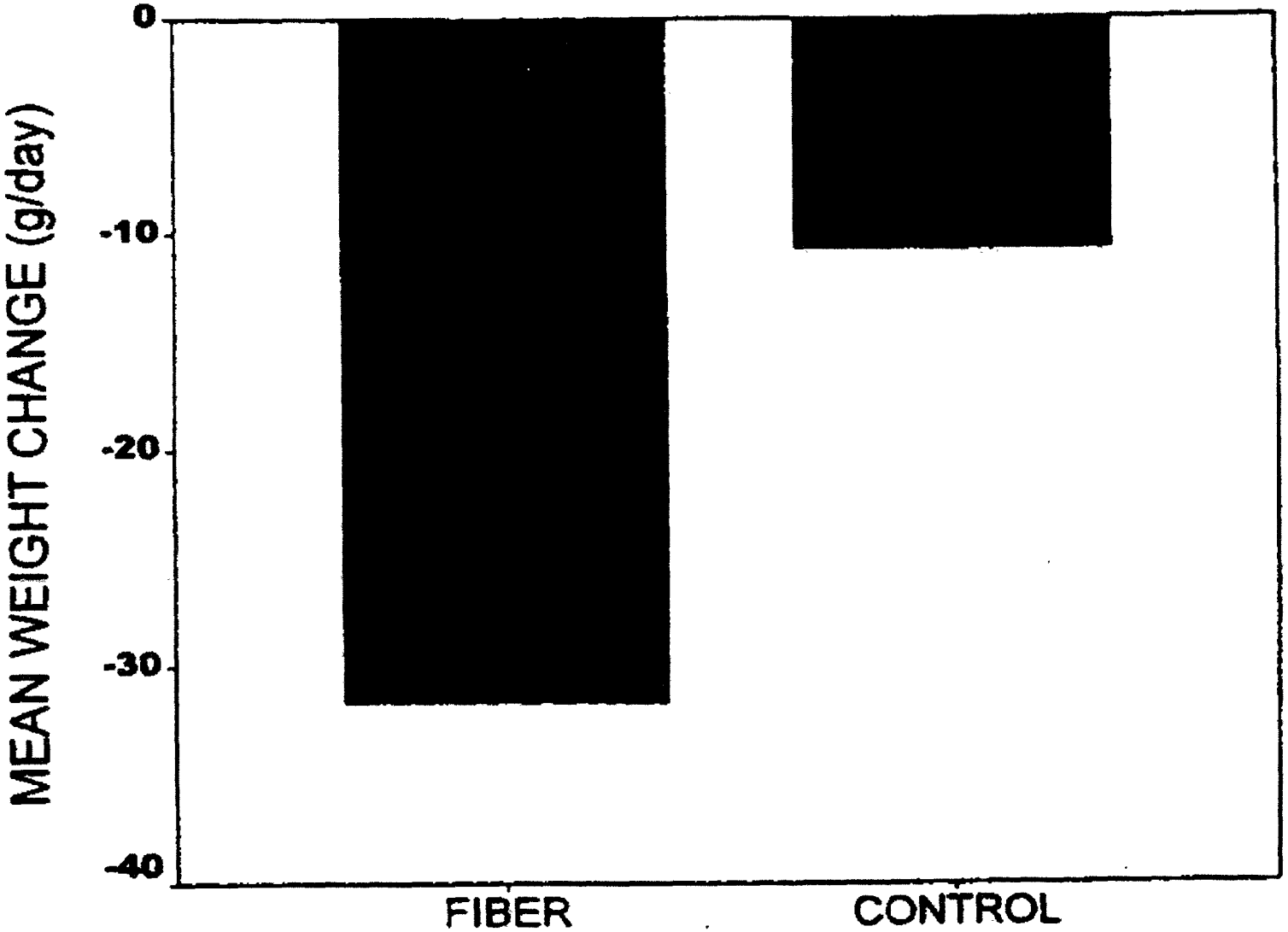
Studies examining the effects of high-fiber versus low-fiber diets

- Percentage reduction in voluntary energy intake in studies
- Each point represents means of treatment groups
- Mean energy intake on the higher-fiber diets was 90% of that on the control diets
- $P < 0.003$


120
100
80
60
40
ENERGY INTAKE (% control value)
Mean=90%
CONTROL
HIGH FIBER

Mean rate of weight loss in 12 ad lib studies

- Significant difference between lower-fiber and higher-fiber groups
- Weight loss was more pronounced in those studies that used obese or overweight individuals as subjects (2.4 kg vs. 0.8 kg)
- Some data that fiber supplements post weight loss aid in weight maintenance


MEAN WEIGHT CHANGE (g/day)
0
-10
-20
-30
-40
FIBER
CONTROL

Do all fibers have the same effects

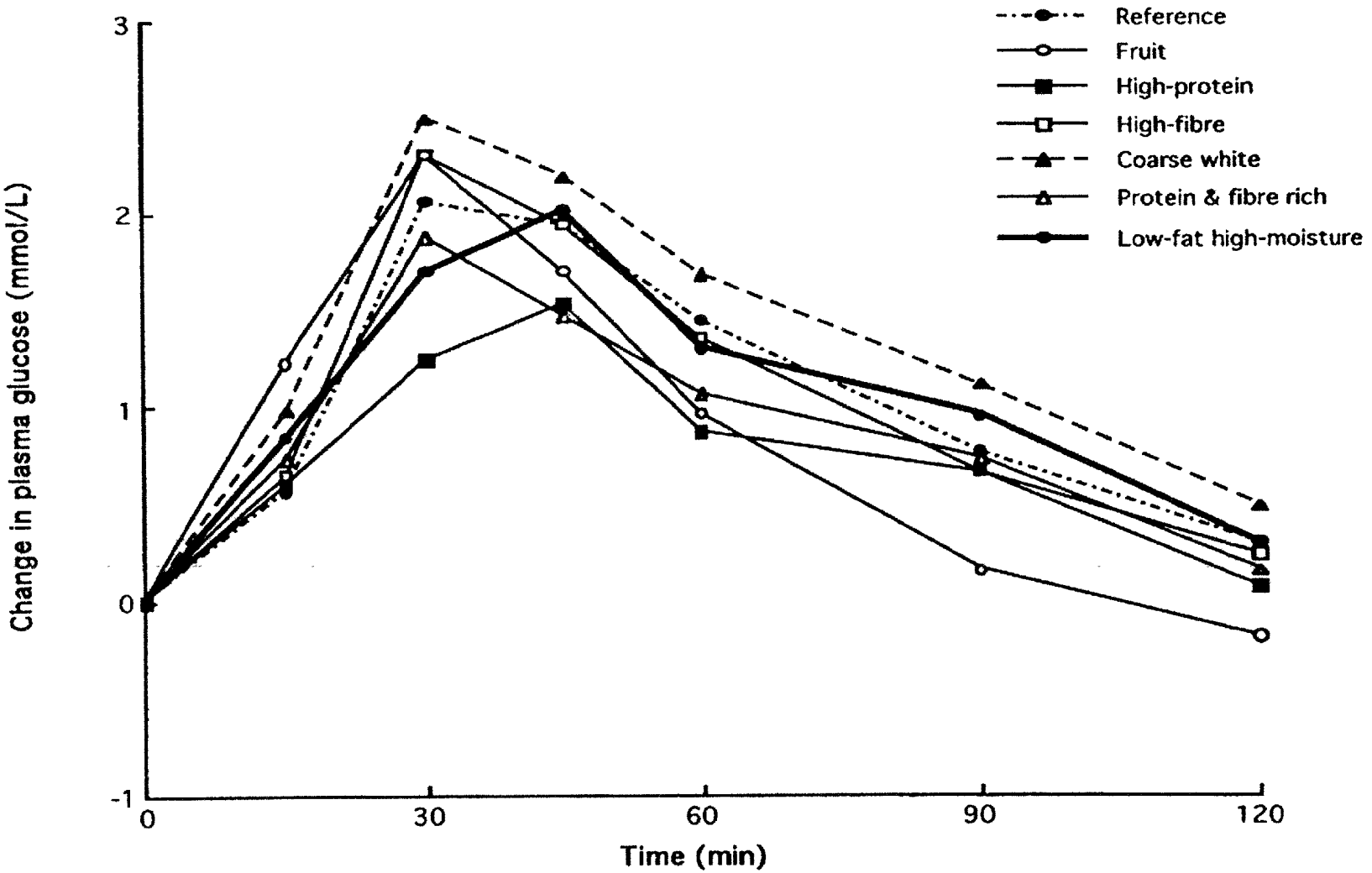
- Crossover comparison of fermentable and nonfermentable fiber supplements (3 week treatment of 27 g/day) in subjects on self-selected diets
- No effect on food intake or body weight loss
- This pilot study does not support use of fiber supplements in promoting weight loss
- Howarth et al. J Nutr 2003;133:3141.

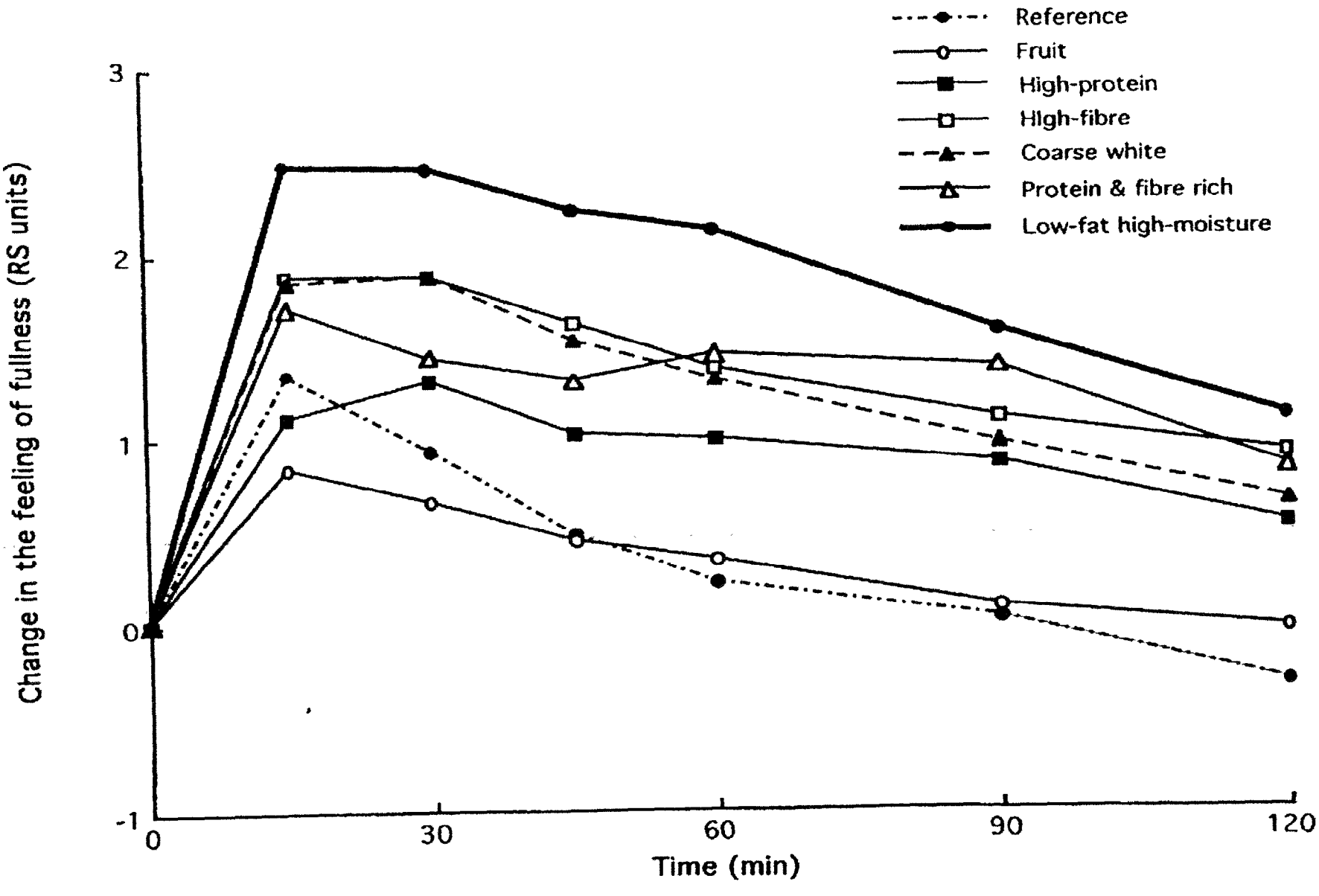
Satiety Index (SI)

- Subjects rate their feeling of fullness using a 7-point scale
- Record time needed to consume the food
- Estimate how much more of the food you would need to eat to completely satisfy hunger
- Holt et al. *J Am Diet Assoc* 2001;101:767

Effects of equal-energy portions of different breads

- Mean SI scores for breads ranged from 100% to 561% with white bread having lowest score
- Strongest predictor of SI was portion size and thus energy density
- GI response was significantly associated with fullness responses


Reference
Fruit
High-protein
High-fibre
Coarse white
Protein & fibre rich
Low-fat high-moisture
Change in plasma glucose (mmol/L)
3
2
1
0
-1
0
30
60
90
120
Time (min)


Reference
Fruit
High-protein
High-fibre
Coarse white
Protein & fibre rich
Low-fat high-moisture
Change in the feeling of fullness (RS units)
3
2
1
0
-1
0
30
60
90
120
Time (min)

Beverage viscosity and postprandial hunger in human

- At weekly intervals, 84 adults ingested 325 ml (220 kcal) shakes matched on weight, volume, temperature, energy, macronutrient content, energy density, rate of consumption, cognitive expectations, palatability, appearance, and requirements for mechanical processing, but varied in viscosity
- Appetite ratings were obtained over 4 hours and dietary intake was recorded for 24 hours

Conclusions

- Significantly greater and more prolonged reductions of hunger were observed with the thicker shake
- Viscosity exerts an independent inverse effect on hunger in humans
- Mattes and Rothacker, *Physiol & Behavior* 2001;74:551

Fiber and Body Mass Index

- Physical activity and dietary fiber, but not dietary fat, are important determinants of subscapular skinfold thickness (Seven Countries Study) (Kromhout et al. Int J Obes 2001;25:301)
- Fiber intake predicts weight gain in CARDIA (Ludwig et al. JAMA 1999;282:1539)

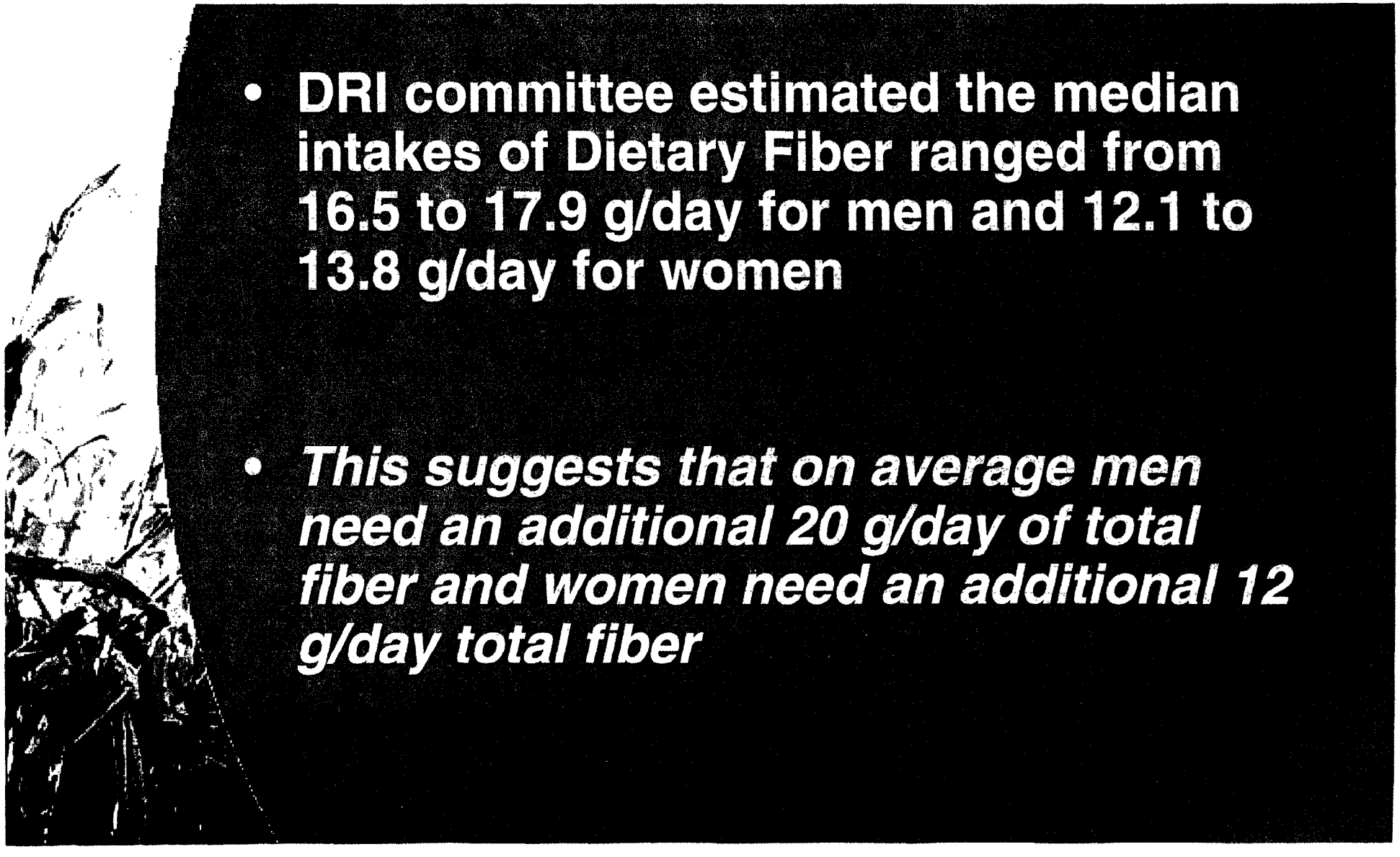
Low carbohydrate diets are low fiber diets

- Low carbohydrate diets are low fiber diets
- Dietary fiber intake estimates for popular diets (1600 kcal) (Anderson et al. J Am Coll Nutr 2000;19:578):
  - Atkins – 4 g/d
  - The Zone – 18 g/d
  - Pritikin – 40 g/d
  - Ornish – 49 g/d

Eating patterns are associated with improved health outcomes

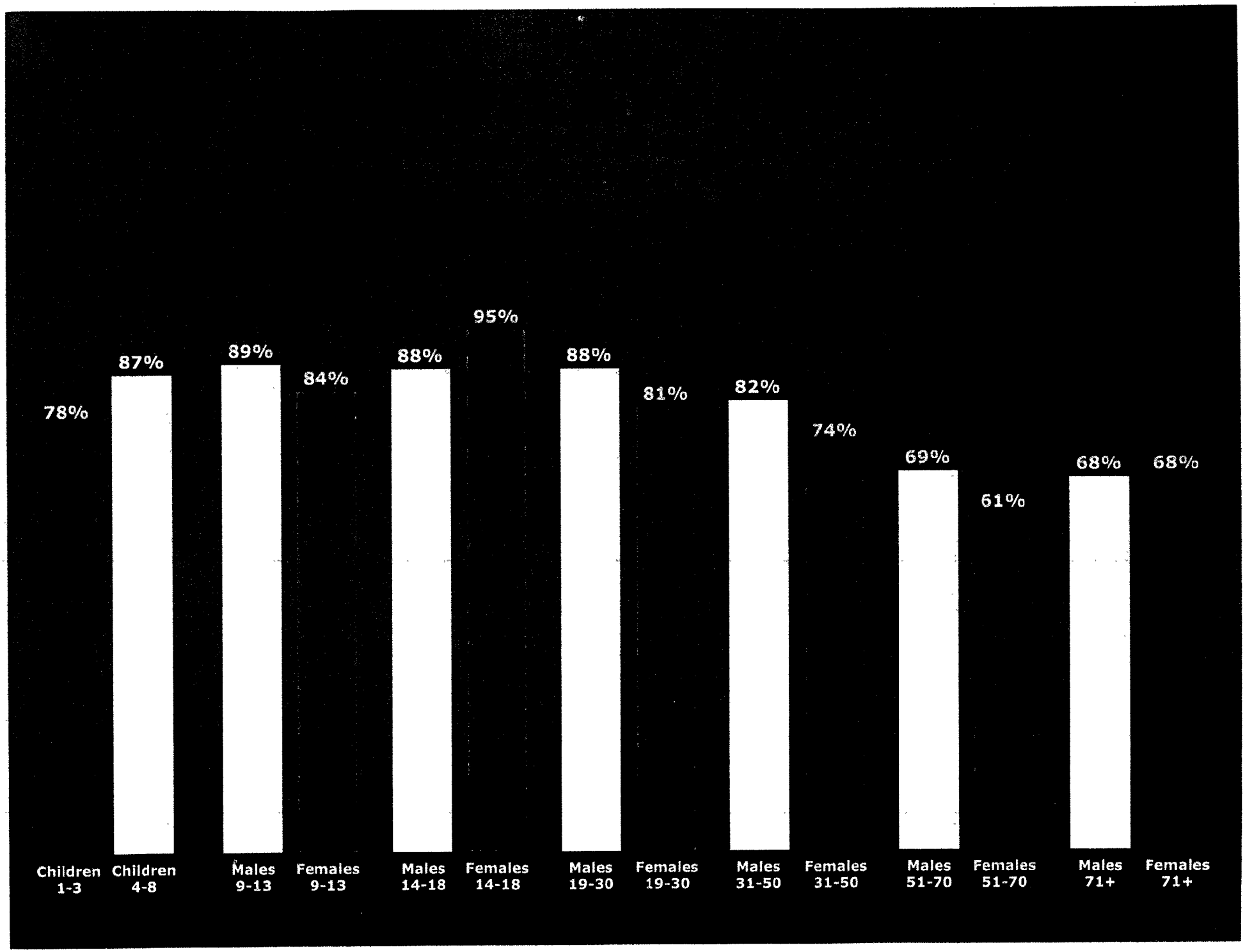
- Consumption of ready-to-eat cereal associated with lower BMI in children aged 4 to 12 years (Albertson et al. J Am Diet Assoc 2003;103:1613)
- Intake of whole grain breakfast cereals inversely associated with total mortality and CVD specific mortality (Liu et al. 2003;77:594-599)
- National Weight Control Registry – eating breakfast important (Wyatt et al. Obesity Res 2002;10:78)

The Fiber Deficit



- DRI committee estimated the median intakes of Dietary Fiber ranged from 16.5 to 17.9 g/day for men and 12.1 to 13.8 g/day for women

- *This suggests that on average men need an additional 20 g/day of total fiber and women need an additional 12 g/day total fiber*


78%
87%
89%
84%
88%
95%
88%
81%
82%
74%
69%
61%
68%
68%
Children 1-3
Children 4-8
Males 9-13
Females 9-13
Males 14-18
Females 14-18
Males 19-30
Females 19-30
Males 31-50
Females 31-50
Males 51-70
Females 51-70
Males 71+
Females 71+

Dietary fiber in common foods (g/serving)

Apple – 3; Banana – 3; Pear – 2

Broccoli – 3; Carrots – 2; Celery – 1; Lettuce –1

WW bread – 2; Oatmeal – 3; White bread – 1

High fiber cereals – Shredded Wheat – 5; All-Bran – 10 -13

Lentils – 7; Split peas – 8

Most commonly-consumed, fiber-containing foods in US – 1-3 g/DF

Meeting the DRI Fiber Recommendation

- Assume 3 grams of dietary per serving of fruit, vegetable, legume, or grain
- For men, need about 12 servings of a fiber-containing food
- For women, need about 8 servings of a fiber-containing food
- Or need to increase fiber content of popular foods – high fiber cereals, use of legumes, dried fruits, fortified foods, or supplements

Food Guide Pyramid

- People eat food not nutrients – need acceptable foods (taste, convenience, familiar) that provide nutrients
- Whole grains are an important vehicle for dietary fiber and other nutrients
- Need strategies to get nutrients including dietary fiber into the low calorie diets required for typically inactive Americans – importance of fruits, vegetables, grains, legumes as base of the pyramid