National Cancer Institute

# Nutrition and Cancer: Examining the Link


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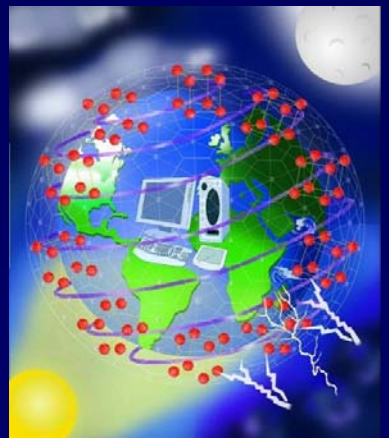
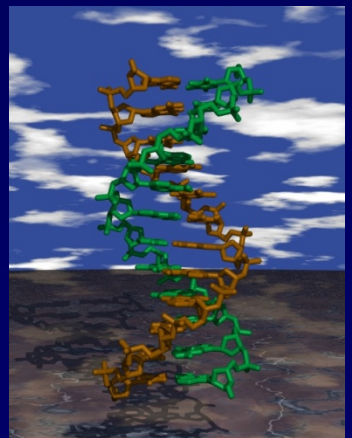
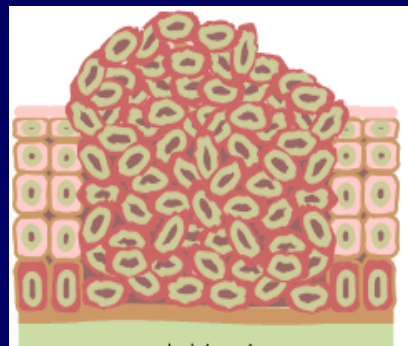
Nutritional Epidemiology Branch

Division of Cancer Epidemiology and Genetics

National Cancer Institute





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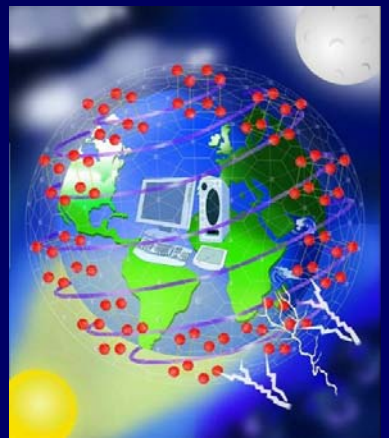
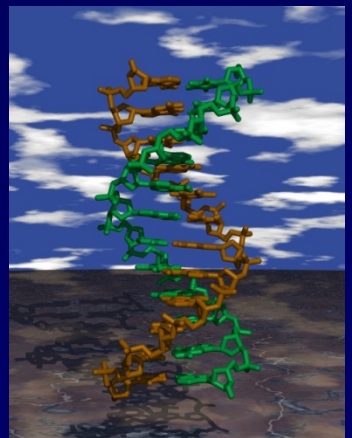
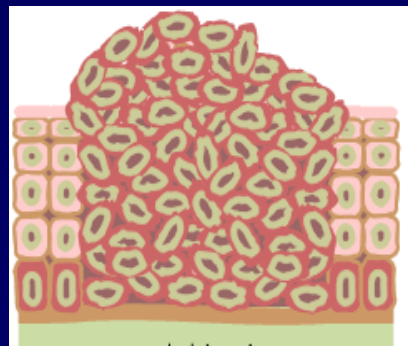
# Nutrition and Cancer: Where Are We Now?

1. History of the nutrition-cancer idea
2. What makes the science complicated
3. Recommendations (in the face of uncertainty)







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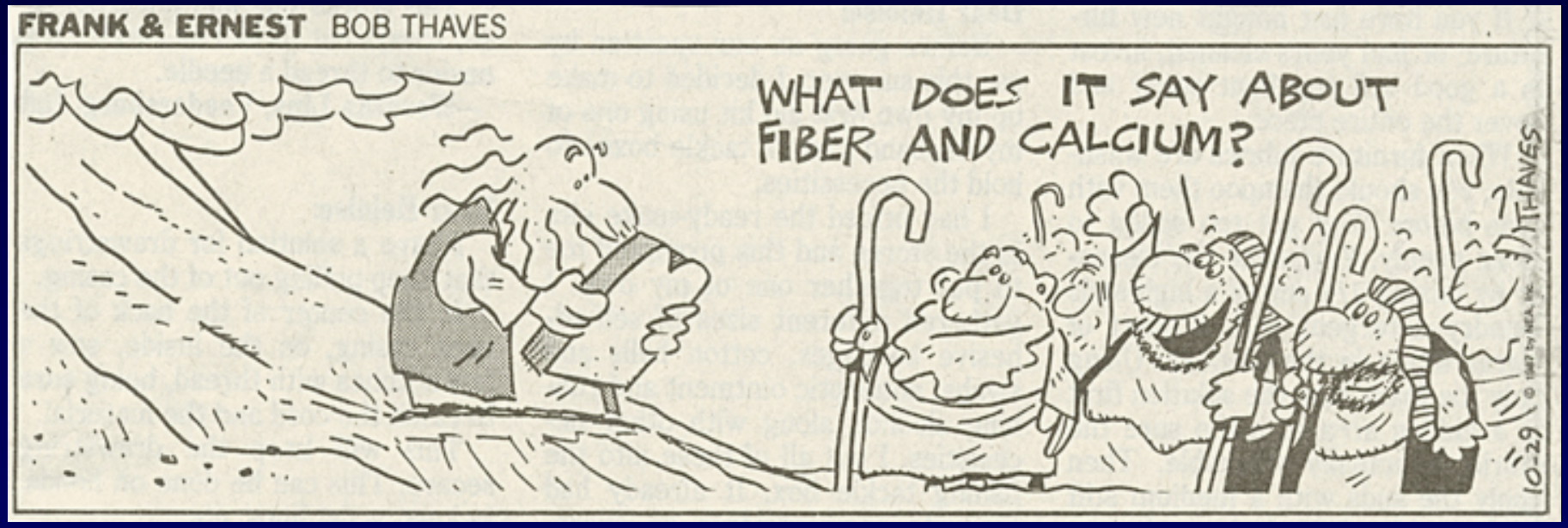
# Magnitude of the Cancer Problem in the World

## (Men and Women Combined: 2002 est.)

- Over 11 million new cases
- Nearly 7 million deaths

Estimates for 2020: 16 million new cases, 10 million deaths


FRANK & ERNEST BOB THAVES
WHAT DOES IT SAY ABOUT FIBER AND CALCIUM?
THAVES
10-29

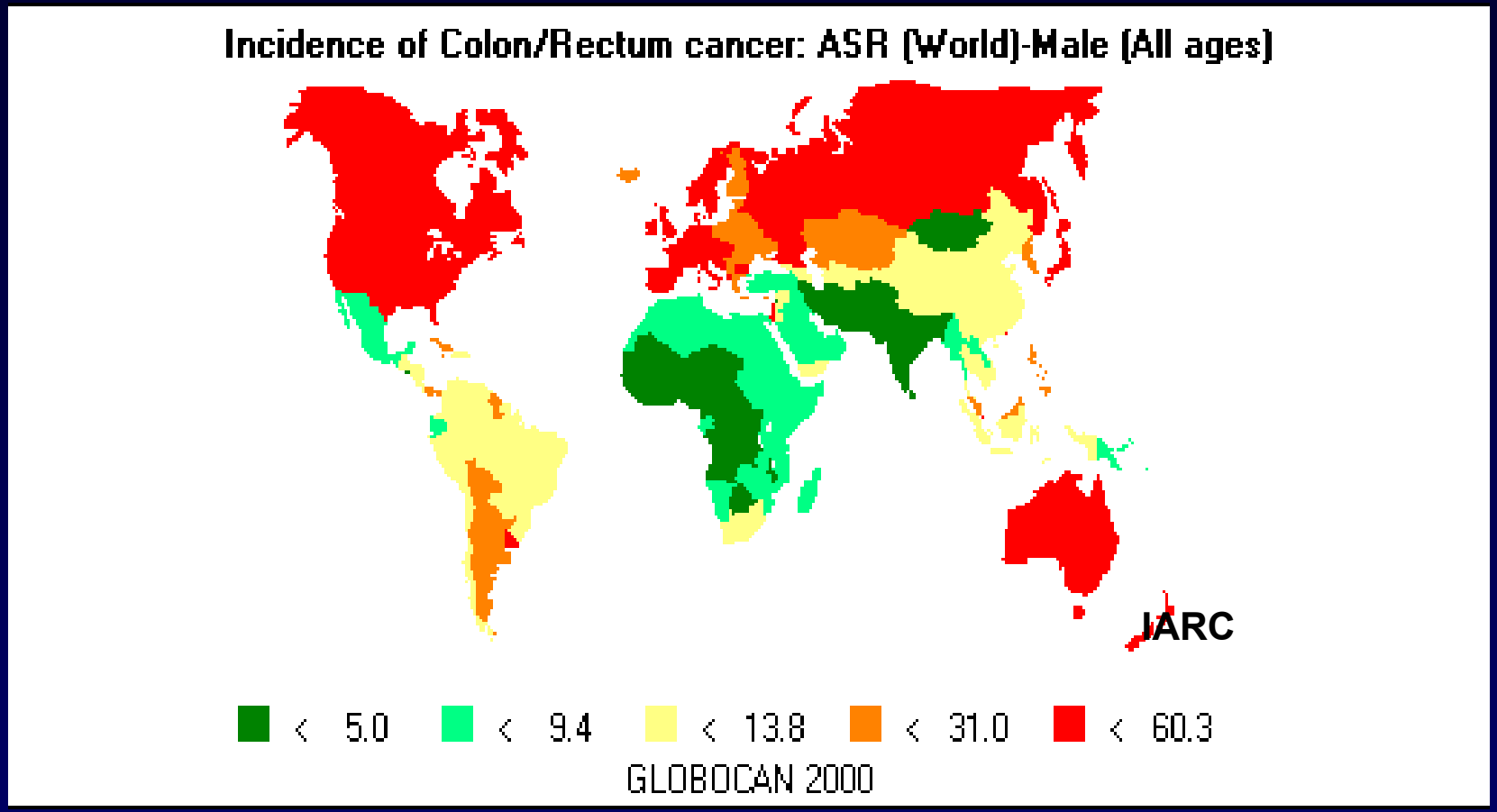
# Diet and Cancer Prevention: History (1)

- Yong-He Yan (Song Dynasty, 960-1279 AD): poor nutrition was cause of esophageal cancer
- Wiseman (1676): cancer might arise ‘from an error in Diet’ and advised abstention from ‘salt, sharp and gross meats’

# Diet and Cancer Prevention: History (2)

- Bennet (1849): 'the circumstances which diminish obesity, and a tendency to the formation of fat, would seem, *a priori,* to be opposed to the cancerous tendency'
- Shaw (1907): advocated more foods of vegetable origin, less foods of animal origin, less alcohol, tea, and tobacco

**Animal experiments have proven conclusively that nutritional change can modulate tumorigenesis —even for genetically-determined neoplasms.**


Incidence of Colon/Rectum cancer: ASR (World)-Male (All ages)
IARC
< 5.0
< 9.4
< 13.8
< 31.0
< 60.3
GLOBOCAN 2000

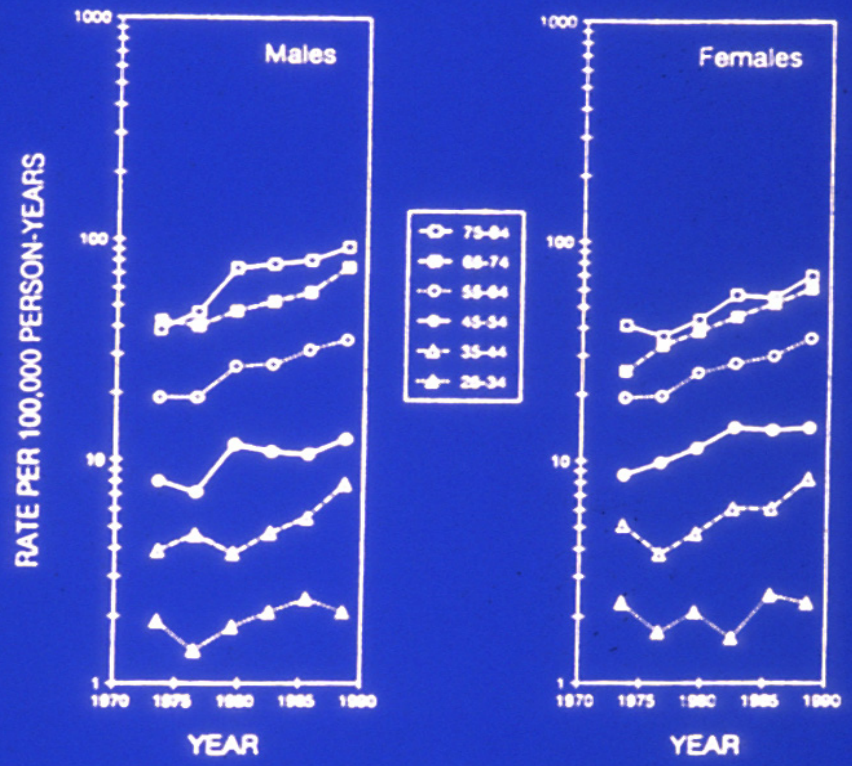
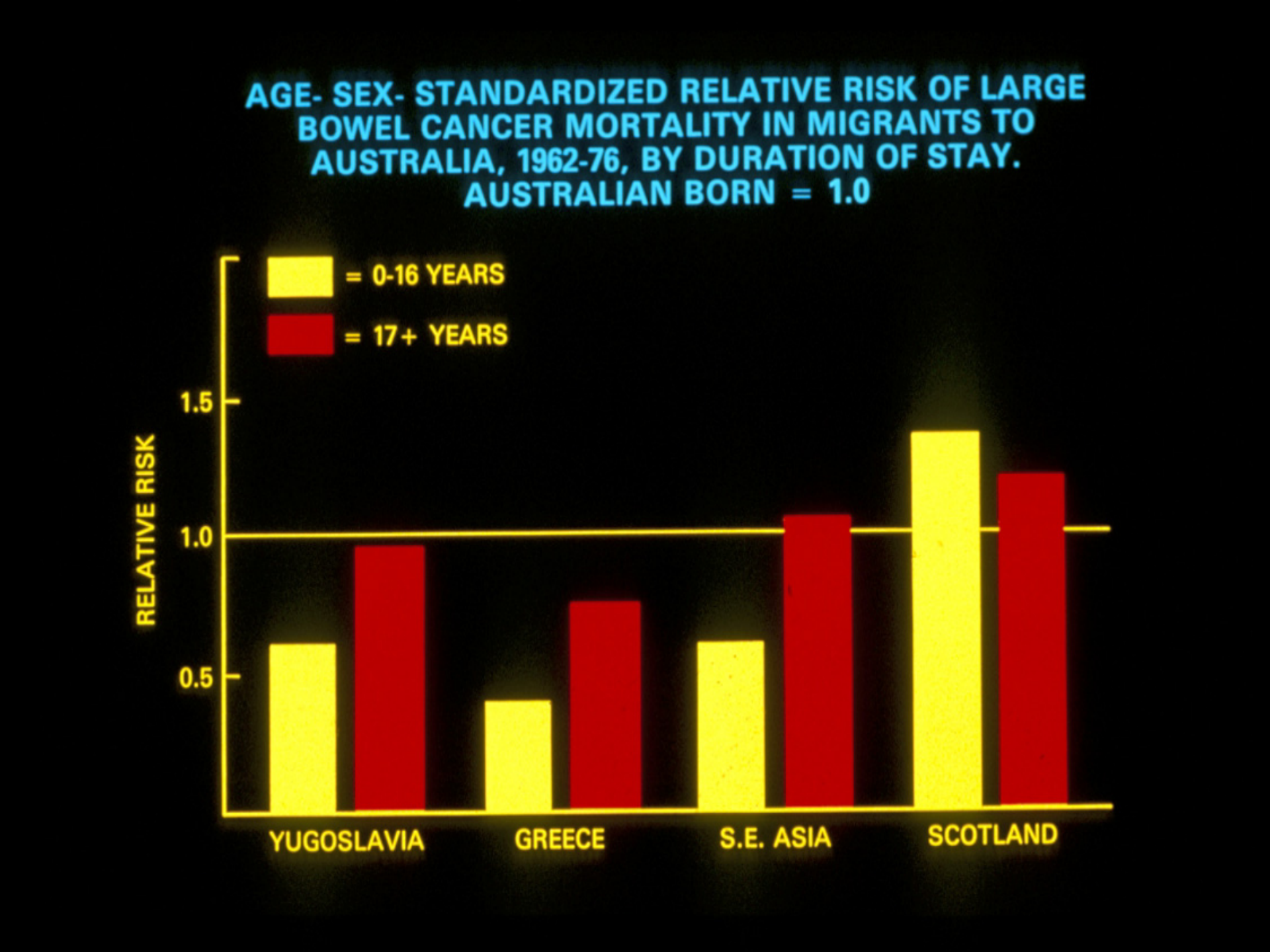



*Fig. 1.* Age-specific colon cancer incidence trends in urban Shanghai, 1972-1974 to 1987-1989. Rates are age-adjusted within 10-year age groups using the world standard.


AGE- SEX- STANDARDIZED RELATIVE RISK OF LARGE BOWEL CANCER MORTALITY IN MIGRANTS TO AUSTRALIA, 1962-76, BY DURATION OF STAY.
AUSTRALIAN BORN = 1.0
= 0-16 YEARS
= 17+ YEARS
RELATIVE RISK
1.5
1.0
0.5
YUGOSLAVIA
GREECE
S.E. ASIA
SCOTLAND

OXFORD MEDICAL PUBLICATIONS

# The Causes of Cancer

Richard Doll and
Richard Peto

# Environmental Causes of Cancer

- Chemicals
- Radiation
- Infectious agents

- Nutrition

# Diet and Cancer Prevention

**The scientific evidence seems ‘softer’ than that for other preventable causes**

*The King reached out to me from beyond the grave, woman says*

# Elvis' picture has cured me of cancer!

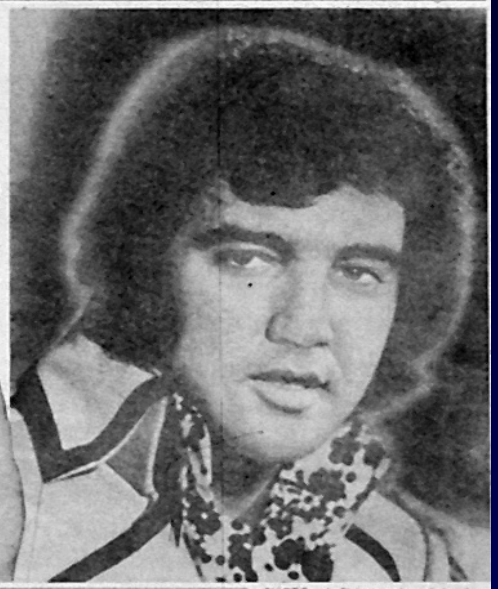


PHOTO of Elvis purchased by her daughter years ago was responsible for her miracle recovery, teacher claims.

By JACK FOLEY

**A 48-year-old woman says a picture of Elvis Presley banished the cancer that was eating her alive!**

"It's a miracle," Catherine Rioni told reporters in Lyon, France. "The doctors said I had terminal abdominal cancer and told me I'd be lucky to live six months.

"That was 11 months ago. Now they say I'm completely cured with almost no possibility of relapse.

"I truly feel that Elvis has given me back my health and second chance at life."

Dr. Andre Voisart confirmed that the schoolteacher no longer has cancer but could only speculate on the cure.

"There are cases of spontaneous healings in the medical literature," he said. "It's possible that she had so much faith in Elvis Presley that her own mind eliminated the cancer."

Mrs. Rioni couldn't disagree more. She thinks Elvis literally reached from beyond the grave and plucked the cancer from her body.

"It all came about by accident," she said. "One night after I had been diagnosed I was sitting at home alone listening to records.

"Just by chance I put on that Elvis song 'In The Ghetto' and glanced at a picture of him that my daughter bought years ago. I don't know how to explain it, but a feeling of peace and serenity seemed to flow into my body.

"I picked up the picture to take a closer look.

"When my finger touched his face I felt like I had been hit by lightning and fell back in my chair with a moan.

"In the dark of my mind I heard a deep, soothing voice tell me: 'Cathy, the Good Lord has work for you to do yet. Cathy, you're cured.' "

Mrs. Rioni says she felt 100 percent better right away.

"As the weeks went on my strength came back and I began to gain weight," she said. "Dr. Voisart noticed it and ran some tests.

"I'll never forget the look on his face when he called me in to hear the results and told me I was cured."

Medical researcher Louis Clement has taken a keen interest in Mrs. Rioni's cure. In the years since Elvis' death 10 years ago, he claims to have investigated 27 reports that the singer's records and pictures have brought about miracle cures.

"We're talking about everything from cancer to psoriasis," the expert told reporters.

## *Stunned doctors find no trace of disease that was killing her*

# Residents tell airlines: Don't flush on us!

**Pigeon droppings are nothing compared to what happened to two shocked homeowners — who were bombarded by frozen waste from the toilets of jet airplanes.**

A chunk of brown ice crashed through the roof of Roger Bange's home in Centreville, Va., and ripped a 2-foot hole in the ceiling of his son's bedroom.

Four days later, a block of blue-green ice tore a hole in the roof of an unidentified homeowner in Fort Worth, Tex.

The potties in commercial planes were to blame in both instances, according to Dirk Stafford of the Federal Aviation Administration.

Bange had no idea what the brown ice was until it began to melt. His worst fears were confirmed by a telephone call to the FAA.

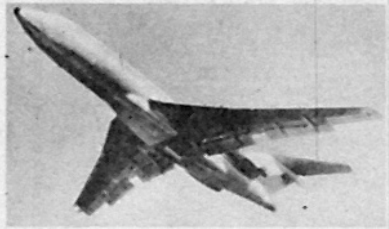
"Brown ice was all over the place," he said. "It got all over everything."

"Both incidents were probably caused by leaky or broken valves on the toilet holding tank of a commercial jet," said Stafford.

"The blue-green ice that struck the Texas home probably formed when the plane reached subfreezing altitudes and dropped off," he said.

"Usually, the ice evaporates in the atmosphere, but sometimes it doesn't," said Stafford.

It is nearly impossible to track down the leaky toilet culprits, according to Stafford.



"We get about a dozen such complaints a year, but many more probably go unreported," he said.

But he didn't offer much relief for the residents.

"I feel sorry for the homeowners, but there isn't much that can be done about it," he said. "It can be a messy situation."

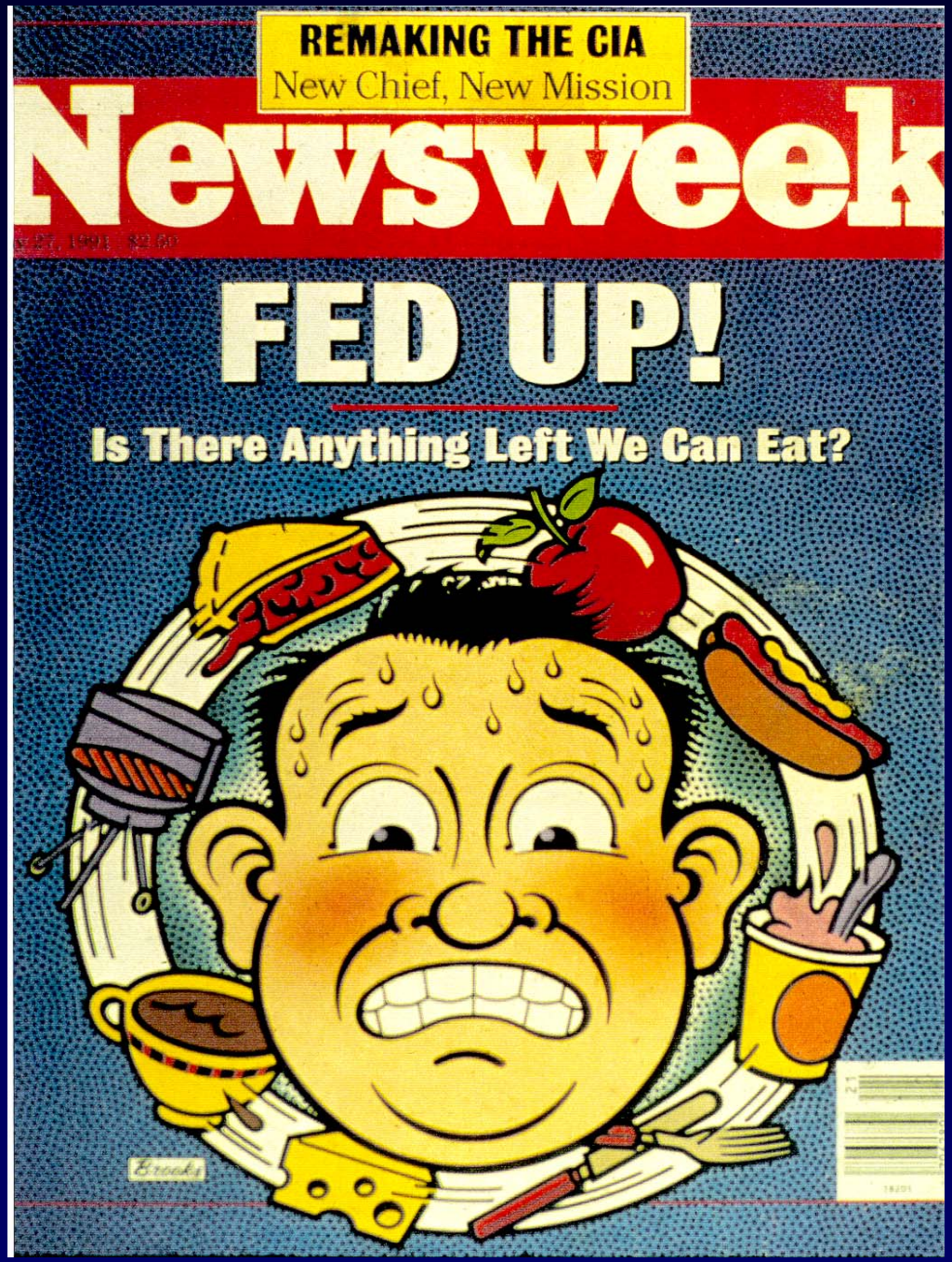
Both of the blitzed homes are near major airports — Dulles International and Dallas-Fort Worth.

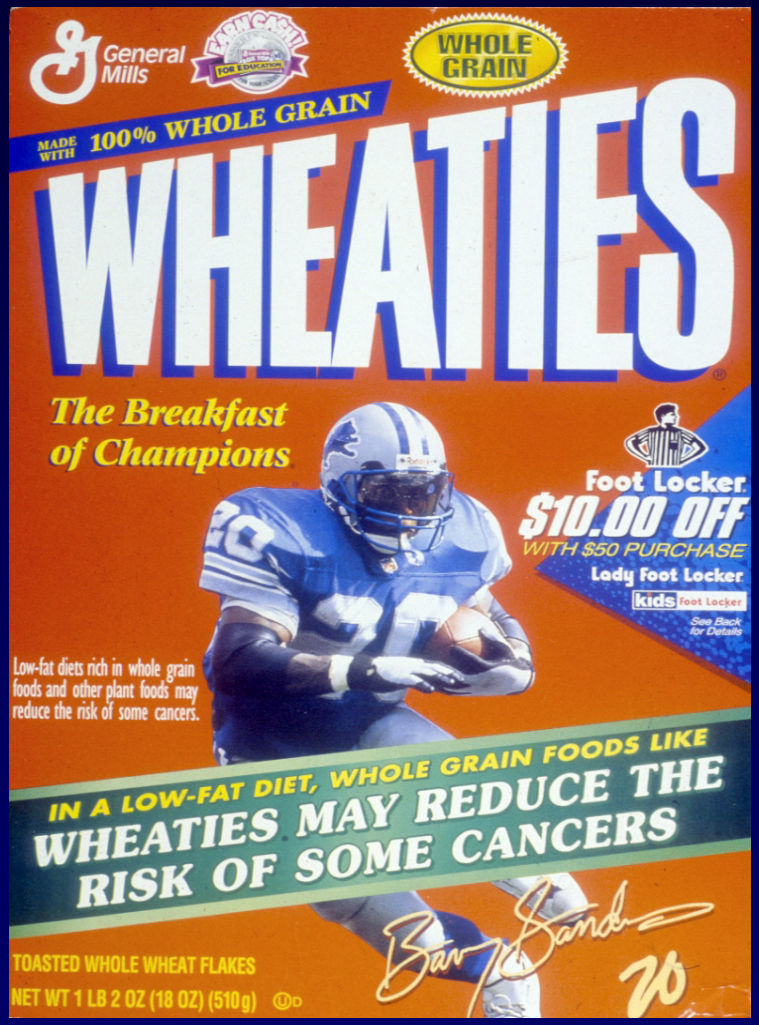
— JACK ALEXANDER

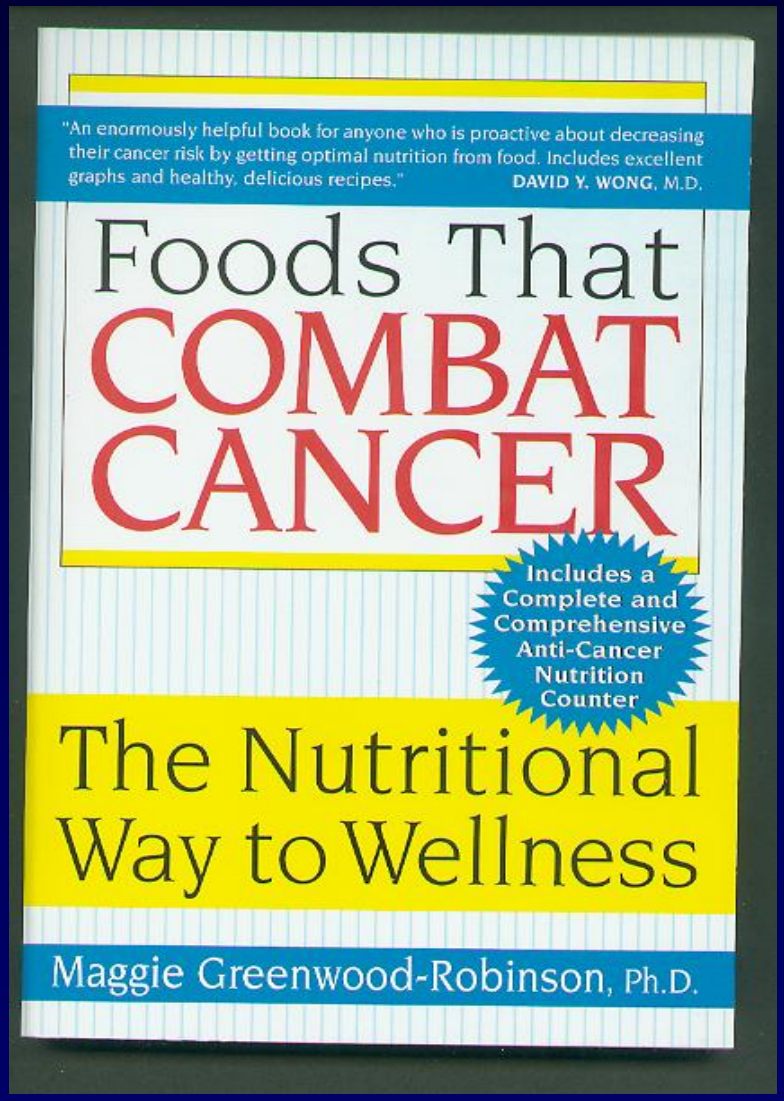
## *Hot peppers may be painkillers*

People who eat chili peppers may be less sensitive to pain, according to a surprising new study at Rutgers University in New Jersey.

Studies have shown that capsaicin, the active ingredient in chili peppers, destroys pain-carrying nerves.


REMAKING THE CIA
New Chief, New Mission
Newsweek
FED UP!
Is There Anything Left We Can Eat?
Brooks


General Mills
WHOLE GRAIN
MADE WITH 100% WHOLE GRAIN
WHEATIES
The Breakfast of Champions
Foot Locker
$10.00 OFF
WITH $50 PURCHASE
Lady Foot Locker
kids foot locker
See Back for Details
Low-fat diets rich in whole grain foods and other plant foods may reduce the risk of some cancers.
IN A LOW-FAT DIET, WHOLE GRAIN FOODS LIKE
WHEATIES MAY REDUCE THE RISK OF SOME CANCERS
TOASTED WHOLE WHEAT FLAKES
NET WT 1 LB 2 OZ (18 OZ) (510g)


"An enormously helpful book for anyone who is proactive about decreasing their cancer risk by getting optimal nutrition from food. Includes excellent graphs and healthy, delicious recipes." DAVID Y. WONG, M.D.
Foods That COMBAT CANCER
Includes a Complete and Comprehensive Anti-Cancer Nutrition Counter
The Nutritional Way to Wellness
Maggie Greenwood-Robinson, Ph.D.

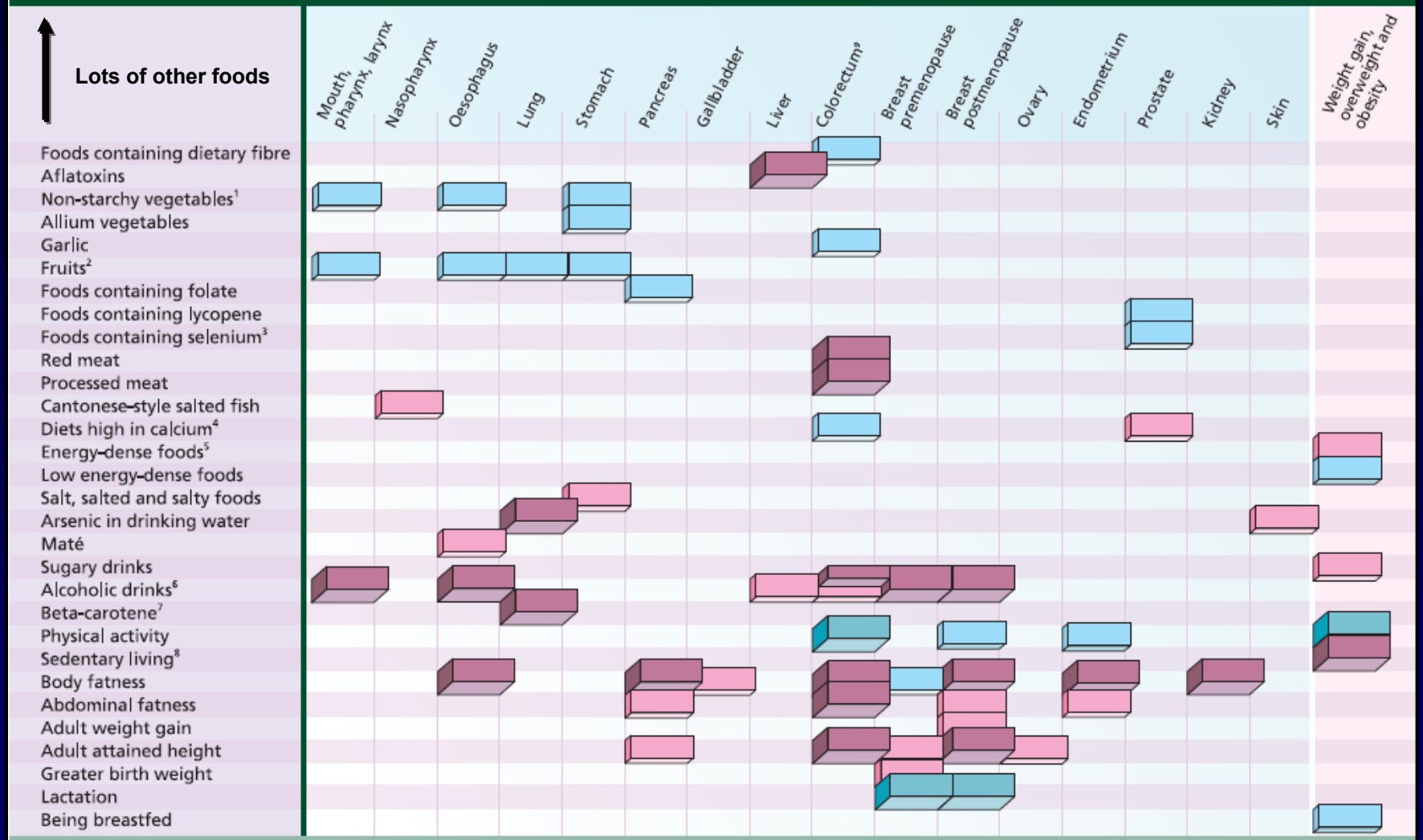
World Cancer Research Fund

American Institute for Cancer Research

# Food, Nutrition, Physical Activity, and the Prevention of Cancer:

## a Global Perspective

## Summary of 'convincing' and 'probable' judgements




**KEY**

- Convincing decreased risk
- Probable decreased risk
- Probable increased risk
- Convincing increased risk

[1] Includes evidence on foods containing carotenoids for mouth, pharynx, larynx; foods containing beta-carotene for oesophagus; foods containing vitamin C for oesophagus

[2] Includes evidence on foods containing carotenoids for mouth, pharynx, larynx and lung; foods containing beta-carotene for oesophagus; foods containing vitamin C for oesophagus

[3] Includes evidence from supplements for prostate

[4] Evidence is from milk and studies using supplements for colorectum

[5] Includes 'fast foods'

[6] Convincing harm for men and probable harm for women for colorectum

[7] The evidence is derived from studies using supplements for lung

[8] Includes evidence on televison viewing

[9] Judgement for physical activity applies to colon and not rectum

World Cancer Research Fund

American Institute for Cancer Research

# Problems for Nutritional Epidemiology of Cancer

**Weak-Moderate Effects**

- Confounding
- Exposure assessment error

# Confounding

- People who consume diets high in fat, or low in fiber, may differ from their low-fat/high-fiber counterparts on other dietary, lifestyle, behavioral, or physiologic characteristics that are truly causally related to cancer.

# % Mortality in Coronary Drug Project Participants

( ) = adjusted for 40 baseline variables)

| Adherence | Clofibrate | Placebo |
|---|---|---|
| < 80% | 24.6 (22.5) | 28.2 (25.8) |
| > 80% | 15.0 (15.7) | 15.1 (16.4) |

--NEJM 1980; 303:1038-41

# Trials (1)

Randomized controlled trials avoid confounding bias because randomization makes intervention and control groups similar with respect to both known and unknown factors related to the disease outcome.

# Trials (2)

- But trials are
  - Not appropriate for all hypotheses
  - Hard to do
  - Expensive

# Trials in the Nutritional Epidemiology of Cancer:

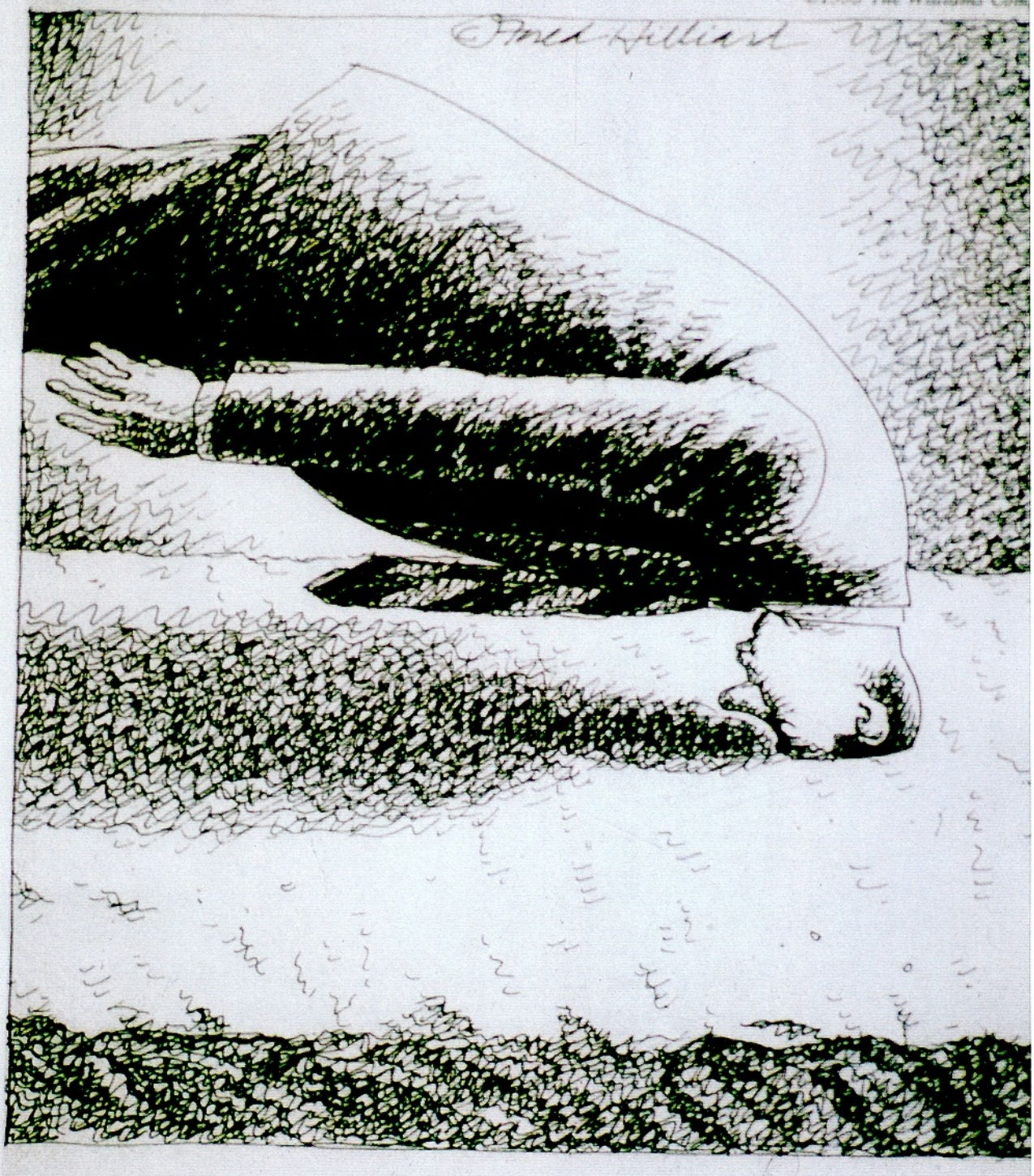
## How's That Working Out?

# Polyp Prevention Trial

# PPT: Risk of Adenoma Recurrence Among Participants Completing the Study

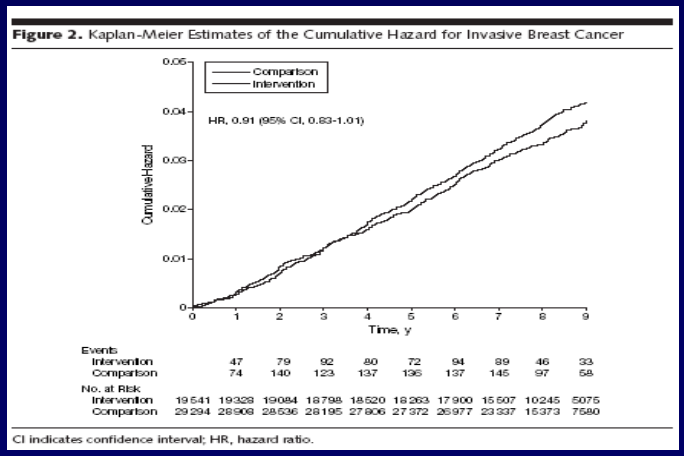
| | INTERVENTION GROUP (N=958) | | CONTROL GROUP (N=947) | | RISK RATIO (95% CI) |
|---|---|---|---|---|---|
| | No. | % | No. | % | |
| 1+ adenoma | 380 | 39.7 | 374 | 39.5 | 1.00 (0.90-1.12) |
| Largest adenoma 1+ cm | 47 | 4.9 | 53 | 5.6 | 0.88 (0.60-1.28) |
| Advanced adenoma | 60 | 6.3 | 66 | 7.0 | 0.90 (0.64-1.26) |

©1999 The Williams Com



# WHI: Diet vs. Breast Cancer

- Change in % calories from fat: 8-10%
- 9.1% ↓ reduction in BC (I vs. C) (p=0.07)
  - vs. 8.8 % ↓ predicted from observ. data




Prentice RL et al. JAMA 2006

# Calcium Supplements vs. Adenoma Recurrence: Trial Results*

| Placebo | Placebo | Calcium | Calcium | RR of 1+ Adenoma | Ratio of mean no. Adenomas |
|---|---|---|---|---|---|
| % with 1+ adenomas | Mean no. adenomas | % with 1+ adenomas | Mean no. adenomas | | |
| 38 | 0.73 | 31 | 0.55 | 0.81 | 0.76 |

Baron J et al., NEJM, 1999

# Folate vs. Adenoma Recurrence

ORIGINAL CONTRIBUTION

## Folic Acid for the Prevention of Colorectal Adenomas

### A Randomized Clinical Trial

Bernard F. Cole, PhD
John A. Baron, MD
Robert S. Sandler, MD
Robert W. Haile, DrPh
Dennis J. Ahnen, MD
Robert S. Bresalier, MD
Gail McKeown-Eyssen, PhD
Robert W. Summers, MD
Richard I. Rothstein, MD
Carol A. Burke, MD
Dale C. Snover, MD
Timothy R. Church, PhD
John I. Allen, MD
Douglas J. Robertson, MD
Gerald J. Beck, PhD
John H. Bond, MD
Tim Byers, MD, MPH
Jack S. Mandel, PhD, MPH
Leila A. Mott, MS
Loretta H. Pearson, MPhil
Elizabeth L. Barry, PhD
Judy R. Rees, BM, BCh, MPH, PhD
Norman Marcon, MD
Fred Saibil, MD
Per Magne Ueland, MD
E. Robert Greenberg, MD
for the Polyp Prevention Study Group

**Context** Laboratory and epidemiological data suggest that folic acid may have an antineoplastic effect in the large intestine.

**Objective** To assess the safety and efficacy of folic acid supplementation for preventing colorectal adenomas.

**Design, Setting, and Participants** A double-blind, placebo-controlled, 2-factor, phase 3, randomized clinical trial conducted at 9 clinical centers between July 6, 1994, and October 1, 2004. Participants included 1021 men and women with a recent history of colorectal adenomas and no previous invasive large intestine carcinoma.

**Intervention** Participants were randomly assigned in a 1:1 ratio to receive 1 mg/d of folic acid (n=516) or placebo (n=505), and were separately randomized to receive aspirin (81 or 325 mg/d) or placebo. Follow-up consisted of 2 colonoscopic surveillance cycles (the first interval was at 3 years and the second at 3 or 5 years later).

**Main Outcome Measures** The primary outcome measure was occurrence of at least 1 colorectal adenoma. Secondary outcomes were the occurrence of advanced lesions (≥25% villous features, high-grade dysplasia, size ≥1 cm, or invasive cancer) and adenoma multiplicity (0, 1-2, or ≥3 adenomas).

**Results** During the first 3 years, 987 participants (96.7%) underwent colonoscopic follow-up, and the incidence of at least 1 colorectal adenoma was 44.1% for folic acid (n=221) and 42.4% for placebo (n=206) (unadjusted risk ratio [RR], 1.04; 95% confidence interval [CI], 0.90-1.20; *P*=.58). Incidence of at least 1 advanced lesion was 11.4% for folic acid (n=57) and 8.6% for placebo (n=42) (unadjusted RR, 1.32; 95% CI, 0.90-1.92; *P*=.15). A total of 607 participants (59.5%) underwent a second follow-up, and the incidence of at least 1 colorectal adenoma was 41.9% for folic acid (n=127) and 37.2% for placebo (n=113) (unadjusted RR, 1.13; 95% CI, 0.93-1.37; *P*=.23); and incidence of at least 1 advanced lesion was 11.6% for folic acid (n=35) and 6.9% for placebo (n=21) (unadjusted RR, 1.67; 95% CI, 1.00-2.80; *P*=.05). Folic acid was associated with higher risks of having 3 or more adenomas and of noncolorectal cancers. There was no significant effect modification by sex, age, smoking, alcohol use, body mass index, baseline plasma folate, or aspirin allocation.

**Conclusions** Folic acid at 1 mg/d does not reduce colorectal adenoma risk. Further research is needed to investigate the possibility that folic acid supplementation might increase the risk of colorectal neoplasia.

**Trial Registration** clinicaltrials.gov Identifier: NCT00272324

*JAMA. 2007;297:2351-2359* www.jama.com

FOLIC ACID AND ITS DERIVATIVES (folate) are essential nutrients in humans and play an important role in nucleotide synthesis and methylation reactions.[1] Folate deficiency leads to macrocytic anemia, and abundant evidence indicates that even in well-nourished western populations, folate supplementation reduces the risk of neural tube defects.[2]

Considerable epidemiological evidence suggests that a low-folate diet is associated with an increased risk of colorectal neoplasia,[3-5] particularly in concert with alcohol, which can antagonize the metabolism of folate.[6,7] Much animal data support an antineoplastic effect of folate. However, in some animal studies, folate deficiency protects against, and supplementation increases, experimental carcinogenesis.[3]

For editorial comment see p 2408.

Author Affiliations are listed at the end of this article. Corresponding Author: Bernard F. Cole, PhD, Dartmouth-Hitchcock Medical Center, 7927 Rubin Bldg, Lebanon, NH 03756 (bernard.cole@dartmouth.edu).

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| End Point | No. (%) of Participants: Placebo (n = 304) | Folic Acid (n = 303) | Unadjusted RR (95% CI) | *P* Value |
|---|---|---|---|---|
| Any adenoma | 113 (37.2) | 127 (41.9) | 1.13 (0.93-1.37) | .23 |
| Advanced lesion | 21 (6.9) | 35 (11.6) | * 1.67 (1.00-2.80) | .05 |
| No. of adenomas | | | | |
| 1-2 | 100 (32.9) | 97 (32.0) | 0.97 (0.77-1.22) | .02 |
| ≥3 | 13 (4.3) | 30 (9.9) | * 2.32 (1.23-4.35) | |

# SELECT

## Selenium and Vitamin E Cancer Prevention Trial

- 32,000 men
- 200 micrograms (µg) of selenium per day
- 400 International Units (IU) of vitamin E per day

National Cancer Institute and Southwestern Oncology Group

D?

# Can Physical Activity/Weight Control Improve Prognosis Among Breast Cancer Survivors?

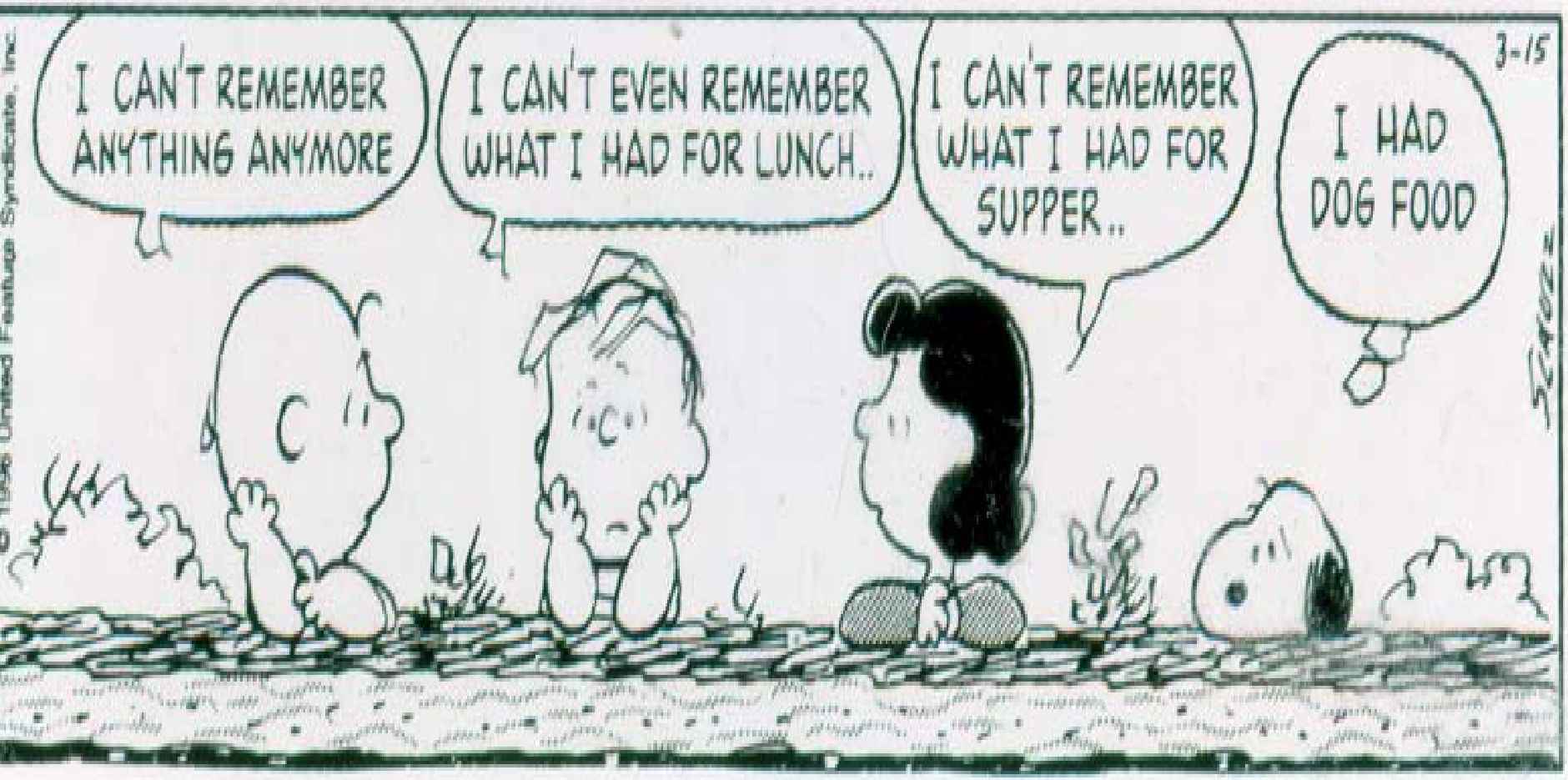
- Smaller trials in Canada, Norway
- Large trial under consideration in U.S

# Problems for Nutritional Epidemiology of Cancer

**Weak-Moderate Effects**

- Confounding
- Exposure assessment error

PEANUTS® by Charles Schulz



OMB #: 0925-0423 EXP. DATE: 09-30-98

NATIONAL INSTITUTES OF HEALTH AND AARP

# DIET AND HEALTH STUDY

## GENERAL INSTRUCTIONS

- Answer each question as best you can. Most of the questions deal with your diet. The rest of the questions deal with other health-related information. For the dietary questions, we are looking for an estimate of what you eat. A guess is better than leaving a blank.
- Use only a No. 2 pencil.
- Be certain to completely blacken-in each of your answers, and erase completely if you make any changes.
- Do not make any stray marks on this form.
- When you complete the questionnaire, please return it in the self-addressed, postage-paid envelope.

INCORRECT MARKS ✓ ✗ ◒ ⊙

CORRECT MARK ●

BEFORE BEGINNING THE QUESTIONNAIRE, PLEASE READ BOXES A AND B.

BOX A

○ ← If the person whose name appears to the left is deceased, please mark this circle, AND DO NOT COMPLETE THIS QUESTIONNAIRE. Please return the blank questionnaire in the self-addressed, postage-paid envelope.

BOX B

We would like this questionnaire filled out BY the person whose name appears to the left. Are you the person whose name appears to the left?

○ Yes
○ No → IF NO, BE SURE THAT YOU ANSWER ALL THE QUESTIONS IN THIS QUESTIONNAIRE ABOUT THE PERSON WHOSE NAME APPEARS TO THE LEFT.

1. Today's date

| MONTH | DAY | YR. |
|---|---|---|
| ○ JAN | | |
| ○ FEB | | |
| ○ MAR | ⓪ ⓪ | ○ 95 |
| ○ APR | ① ① | ○ 96 |
| ○ MAY | ② ② | ○ 97 |
| ○ JUN | ③ ③ | |
| ○ JUL | ④ | |
| ○ AUG | ⑤ | |
| ○ SEP | ⑥ | |
| ○ OCT | ⑦ | |
| ○ NOV | ⑧ | |
| ○ DEC | ⑨ | |

2. Date of birth

| MONTH | DAY | YR. |
|---|---|---|
| ○ JAN | | |
| ○ FEB | | |
| ○ MAR | ⓪ ⓪ | ⓪ ⓪ |
| ○ APR | ① ① | ① ① |
| ○ MAY | ② ② | ② ② |
| ○ JUN | ③ ③ | ③ ③ |
| ○ JUL | ④ | ④ ④ |
| ○ AUG | ⑤ | ⑤ ⑤ |
| ○ SEP | ⑥ | ⑥ ⑥ |
| ○ OCT | ⑦ | ⑦ ⑦ |
| ○ NOV | ⑧ | ⑧ ⑧ |
| ○ DEC | ⑨ | ⑨ ⑨ |

3. Your current height

| FEET | INCHES |
|---|---|
| | ⓪ |
| | ① |
| | ② |
| | ③ |
| ④ | ④ |
| ⑤ | ⑤ |
| ⑥ | ⑥ |
| ⑦ | ⑦ |
| | ⑧ |
| | ⑨ |
| | ⑩ |
| | ⑪ |

4. Your current weight

| POUNDS |
|---|
| ⓪ ⓪ ⓪ |
| ① ① ① |
| ② ② ② |
| ③ ③ ③ |
| ④ ④ ④ |
| ⑤ ⑤ ⑤ |
| ⑥ ⑥ ⑥ |
| ⑦ ⑦ ⑦ |
| ⑧ ⑧ ⑧ |
| ⑨ ⑨ ⑨ |

STATEMENT OF CONFIDENTIALITY

Collection of this information is authorized by The Public Health Service Act, Section 412 (42 USC 285a-1) and Section 413 (42 USC 285a-2). Rights of study participants are protected by the Privacy Act of 1974. Participation is voluntary, and there are no penalties for not participating or withdrawing from the study at any time. Refusal to participate will not affect your AARP membership in any way. The information collected in this study will be held in professional confidence. Names and other identifiers will be separated from information provided and will not appear in any report of the study. Information provided will be combined for all study participants and reported as statistical summaries.

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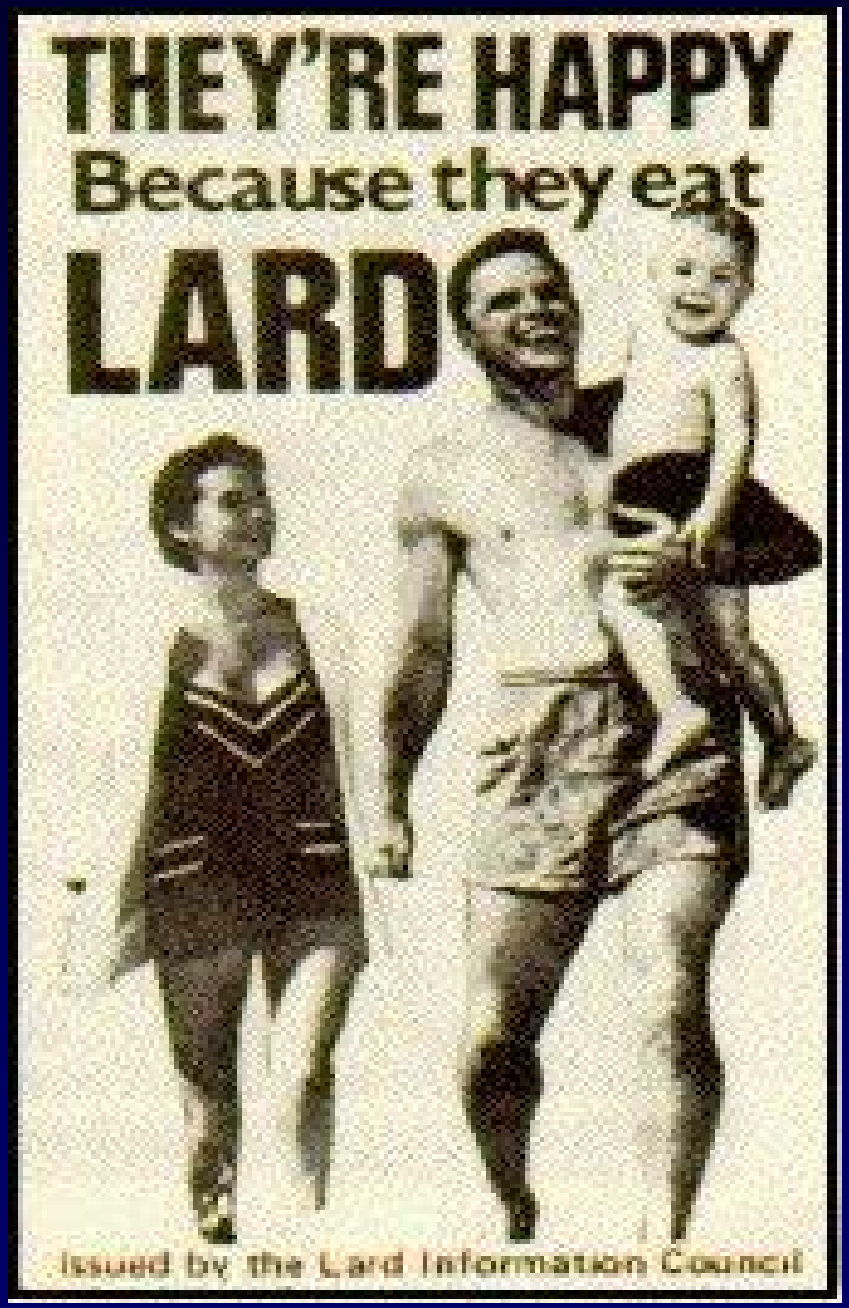
| TYPE OF FOOD | HOW OFTEN | | | | | | | | | | HOW MUCH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Over the last 12 months, how often did you eat the following foods? (Ignore any recent changes.) | Never | 1-6 Times Per Year | 7-11 Times Per Year | 1 Time Per Month | 2-3 Times Per Month | 1-2 Times Per Week | 3-4 Times Per Week | 5-6 Times Per Week | 1 Time Per Day | 2+ Times Per Day | YOUR PORTION SIZE |
| Applesauce | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ Less than 3/4 cup<br>○ 3/4 to 1 1/2 cups<br>○ More than 1 1/2 cups |
| Apples | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ Less than 1 apple<br>○ 1 apple<br>○ More than 1 apple |
| Pears (fresh, canned, frozen) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ Less than 1 pear or 1/2 cup<br>○ 1 pear or 1/2 cup<br>○ More than 1 pear or 1/2 cup |
| Bananas | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ Less than 1 banana<br>○ 1 banana<br>○ More than 1 banana |

PAGE 4

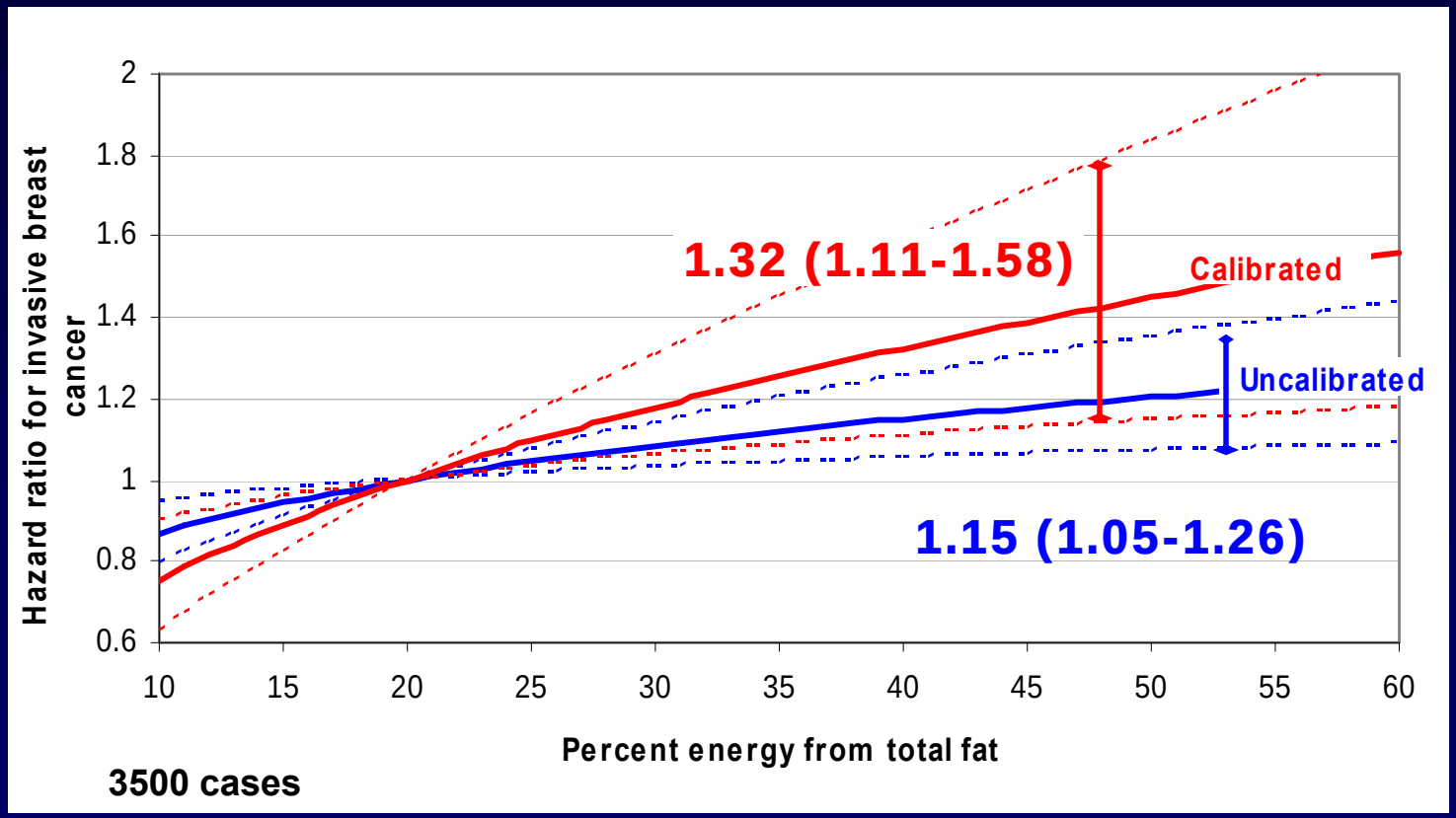
# FFQ used in NIH-AARP Diet and Health Study

DIET AND HEALTH STUDY
NATIONAL INSTITUTES OF HEALTH

NIH AARP


THEY'RE HAPPY
Because they eat
LARD
Issued by the Lard Information Council

# Dietary Fat and Breast Cancer



ARTICLE

Dietary Fat and Postmenopausal Invasive Breast Cancer in the National Institutes of Health–AARP Diet and Health Study Cohort

Anne C. M. Thiébaut, Victor Kipnis, Shih-Chen Chang, Amy F. Subar, Frances E. Thompson, Philip S. Rosenberg, Albert R. Hollenbeck, Michael Leitzmann, Arthur Schatzkin

Background

Methods

Results

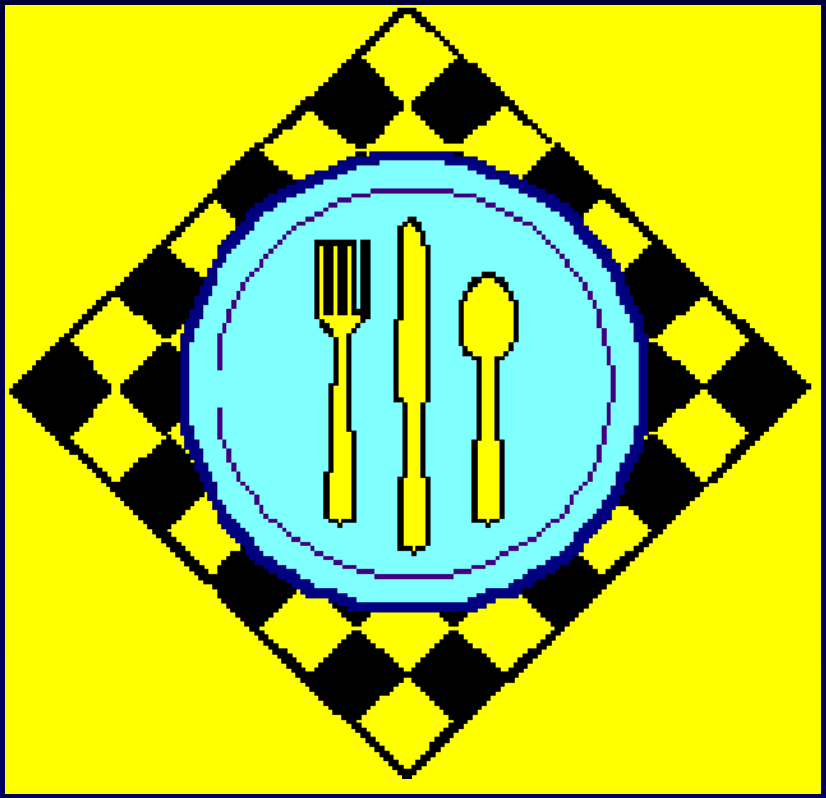
Conclusion

J Natl Cancer Inst 2007;99:451-62

Calibration study (1996): n=2055; 2 FFQs, 2 24HDRs

Thiébaut et al. JNCI 2007;99:451-62

# OPEN STUDY



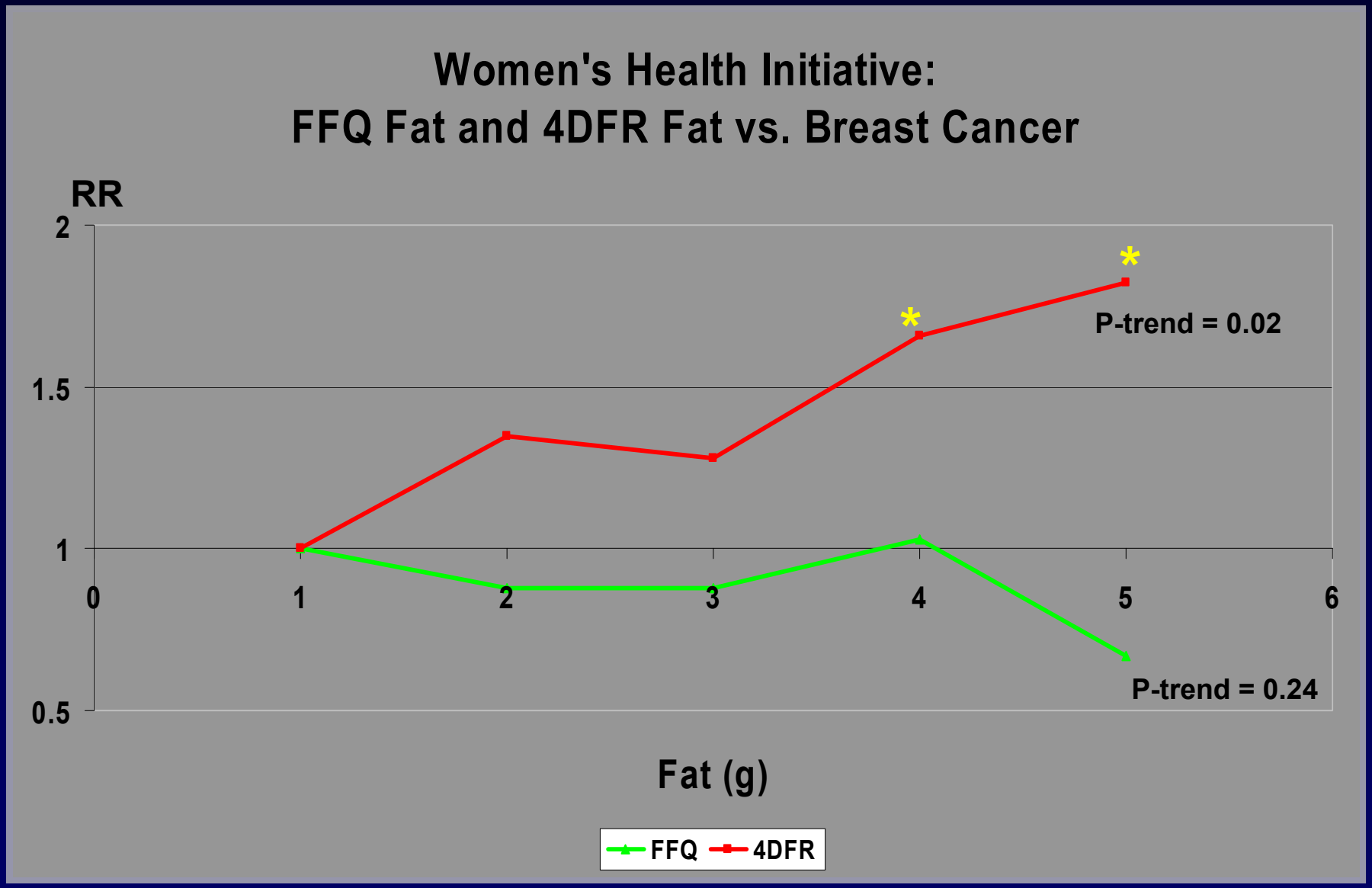
Observing Protein and Energy Nutrition Study

# OPEN: Methods

- n=486 men and women, age 40-69
- 2 FFQs, 2 24-hour dietary recalls
- Biomarkers
  - 2 24-hour urines for nitrogen (protein)
  - Doubly labeled water (DLW) for energy expenditure (with replications in substudy)

# Conclusions

- There is substantial attenuation for FFQ-derived absolute energy and protein (RR of 2.00→ 1.03-1.10)
- Attenuation is reduced by energy adjustment but remains considerable (RR of 2.00→ 1.24-1.32)




*CI excludes 1.0

*Editorial*

## Is It Time to Abandon the Food Frequency Questionnaire?

Alan R. Kristal, Ulrike Peters, and John D. Potter
Cancer Prevention Program, Fred Hutchinson Cancer Research Center, Seattle, Washington

Although pointed to which, it is possible that epidemiologists have been dubious in their acceptance of food frequency questionnaires (FFQ) as the standard tool for dietary assessment in large studies of diet and cancer. The substantial limitations of FFQs have been known for some time (1) and published studies based on FFQ-derived data have long included in their discussion sections a litany of weaknesses due to suboptimal dietary assessment. However, few of us expected the association between your measurement characteristics of FFQs when compared with directly labeled water in gold standard for energy intake (vol. 2), we had to expected to have that diet and cancer associations detected when dietary assessment is based on dietary biomarkers (e.g., vol. 3) or food records (4) are underestimable when based on FFQs. We are having a crisis based only of millions of dollars and many years study' cancers have been tested in studies using only FFQs to measure diet, but it is good that the results that have not been, and will not be, able to answer many if not most questions about diet and disease risk.

This concern may have been heard in the [illegible]. Here, I describe how FFQs were developed and why they became the standard measure of diet in epidemiological research. Second, it suggests several directions for future research and practice to improve dietary assessment in studies of diet and disease.

### Development and Acceptance of the Food Frequency Questionnaire for Studies of Diet and Cancer

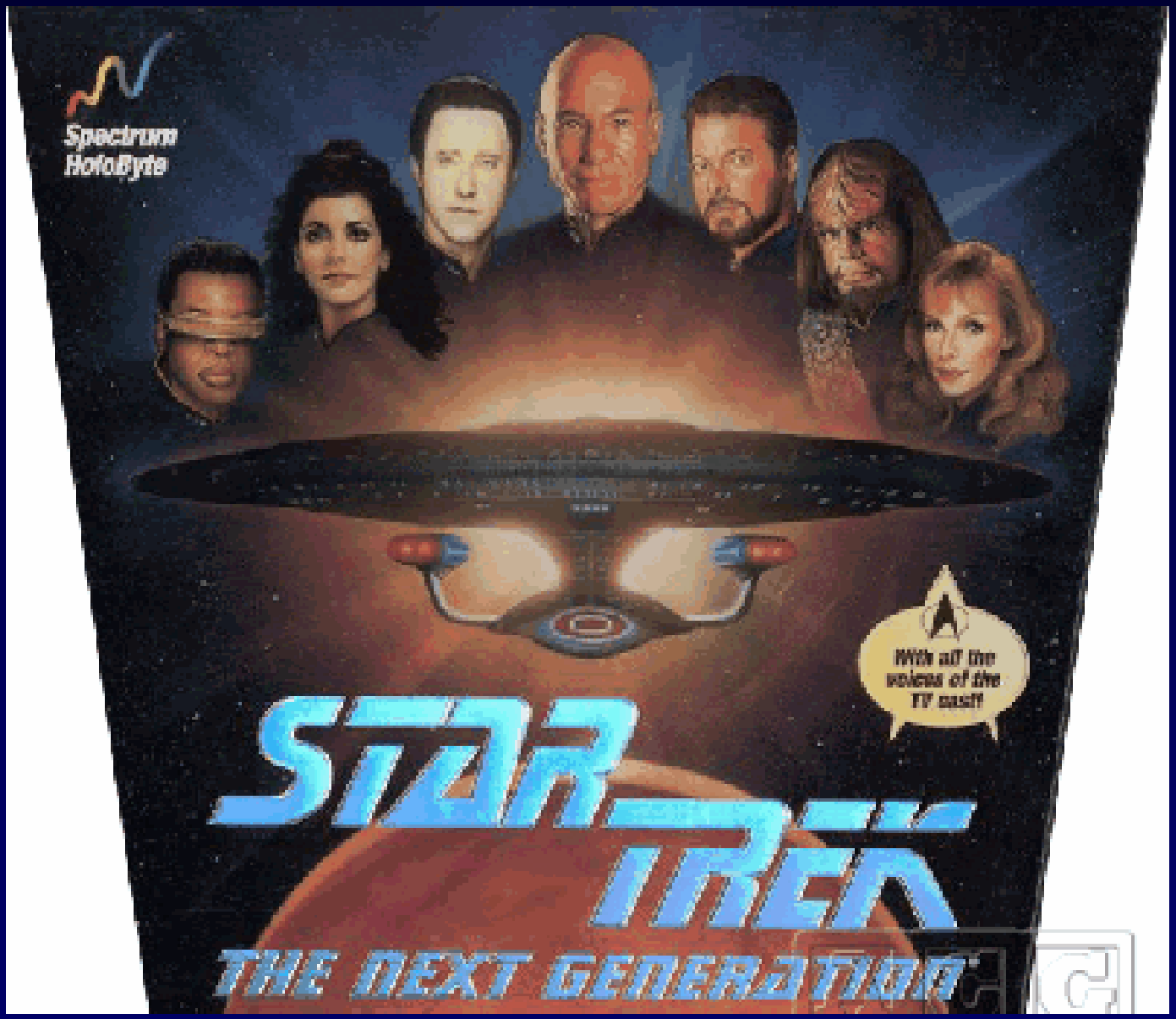
In 1985, Doll and Peto (5) published a landmark report in which they estimated that 35% of the range of risk (35% to 70%) of cancer to an individual is due to diet. The European evidence for this conclusion was largely based on international ecological studies in which cancer incidence or mortality were correlated with estimates of per capita food disappearance. Given the obvious limitations of these studies, [illegible] cancer, more specifically, large cohort studies were needed to test more refined hypotheses about diet and for nutrients and disease risk. Above all early successes [illegible] need a technique called "diet history" to assess either current or past diet. Diet histories were lengthy, opinionated, and structured food interviews administered and analyzed by nutritionists, which attempted to characterize what a study participant "usually" ate (6). When used in case-control studies, diet histories are highly subject to bias, given the difficulty and rarity of interviews (and, of course, participant blinding). And because the interviews took [illegible] minutes, it was unrealistic to be large cohort studies. Thus, out of necessity, [illegible] a simplified, self-administered, and inexpensive form of the diet history, the food frequency questionnaire (7).

Much research has been focused on both evaluating and improving FFQs in dedicated studies of [illegible] measures in food [illegible] and [illegible] validity, and associations with "objective" measures such as body mass index and serum [illegible] concentrations. We learned that what individuals are asked to recall diet in the very recent past, their optimal recovery is reasonable [illegible] but as we go further back in time, especially in recovery of diet in [illegible] and small of past diet is constructed from general knowledge about foods, [illegible] probably based on both [illegible] about one's usual or characteristic diet (8). Thus, with the exception of commercial foods (e.g., [illegible] "Thanksgiving and earlier of [illegible] Year's of foods in a month, small of [illegible] past diet (e.g., "How often did you eat a 1/2 cup serving of [illegible] over the past year?") [illegible] to expect that only [illegible]. We learned that FFQs are reproducible, with test-retest correlations for most nutrients in the range of 0.5 to 0.8. However, validity determined [illegible] based on comparisons with [illegible] diet records or 24-hour recalls, is generally not good. Correlations between FFQs and recall data of nutrients are often [illegible] and rarely [illegible]. Associations of FFQs with [illegible] are [illegible] than are those of dietary biomarkers are generally weaker, although this might be expected to be due to the simplicity and [illegible] relationships between diet and dietary biomarkers. Hypothesis of poor validity usually [illegible] to [illegible] statistical adjustment for total energy or dietary validity, but this does not change the fact that disease associations between an FFQ and a [illegible] measure ranges from 0% to 40% and that results of this disease [illegible] may [illegible] be considered [illegible]. Although [illegible] of disease risk in [illegible] "validation study" is accepted, the FFQ is termed "validated" or [illegible] acceptable to study [illegible] and measure [illegible].

Although [illegible] in the validity of FFQs to measure diet [illegible] were either [illegible] in [illegible], most scientists believed that there was no [illegible] to dietary measures based on [illegible] consumption, [illegible] diet history [illegible], and food records [illegible] to be used to measure [illegible] because the expense of [illegible] such a study [illegible] disease [illegible]. Nor would measures based [illegible] consumption be used in large cohort studies, in large part due to costs. For example, as part of the design of the Women's Health Initiative, [illegible] in FFQs were considered. The estimated costs of dietary assessment at baseline of our [illegible] women were [illegible] and [illegible] in FFQs is [illegible] and [illegible] in [illegible] and [illegible] in [illegible] dietary recalls. Although we may wish to measure a large cohort study using gold [illegible] results [illegible] "gold standard" but certainly not 24-hour recall, the [illegible] of obtaining [illegible] such a study is [illegible].

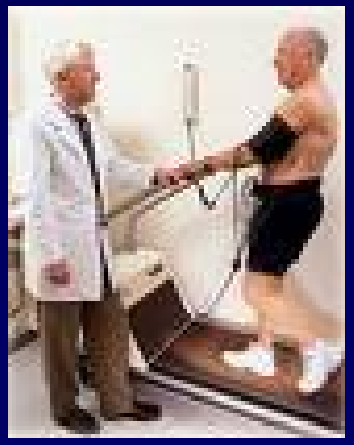
These relatively recent developments have [illegible] bright lights on the limitations of FFQs. This [illegible] the general [illegible] of consistently [illegible] validity and [illegible] and cancer risk. For example, early findings in large cohorts were [illegible] of [illegible] term [illegible] (10), and many of the [illegible] of diet and cancer risk from [illegible] studies could not be replicated in cohort studies (11) or in dietary trials (12, 13). Perhaps, due to low participation rates among eligible controls, case-control studies were detecting problems of study participation rather than dietary risk factors for disease. The second development was the publication of the Observing Protein and Energy Nutrition study (3), which compared results from a validated gold FFQ to two [illegible] which a very [illegible] between total and [illegible] and [illegible] measurement error between total and [illegible] and [illegible] based on [illegible] using a 7-day diet record. [illegible] highest [illegible] (95% CI, [illegible]) [illegible] and [illegible] using a FFQ the highest [illegible] (95% CI, [illegible]) [illegible] and [illegible]). On this basis, [illegible] et al. suggested that an important association with dietary fat [illegible] based on [illegible] have not [illegible] in other studies. The findings in Hingham et al., however, raised doubts [illegible] the validity of the Women's Health Initiative (4) trial [illegible] women High fat groups, RR = 0.90; 95% CI, 0.80–1.02). If the United States [illegible] on the [illegible] correct, the Women's Health Initiative trial should have stopped years ago. Moreover, the validity of dietary trial [illegible] by FFQ has been [illegible] by comparison with [illegible] biomarkers and [illegible] In addition, with the massive numbers of men in the prospective studies (200 men, for 5% of men [illegible] total fat intake [illegible] 95% CI, 0.96–1.00), it is quite unlikely that an association of the magnitude reported by Hingham et al. for total [illegible] intake during middle [illegible] lower fat has been missed due to measurement error.

Underlying the concerns of Kristal et al. seems to be the lack of support for large prospective studies for several [illegible] diet cancer hypotheses. However, using the same question [illegible] and prospectively, clear and consistent associations have been seen between various aspects of diet and risk of [illegible] heart disease and type 2 diabetes (14, 15) and with biomarkers that likely [illegible] these relationships (16). This although it is possible that small effects have been missed, the lack of hypothesized associations in large studies of diet and cancer are at least [illegible] by the [illegible] analyses in [illegible] dietary [illegible] by FFQs to differences in diet or to lack of variation in diet within the prospective studies. One possibility is that the hypotheses in which we are testing have been [illegible] are not true. Another possibility is that the temporal relationship between diet and cancer has not yet been [illegible] dietary [illegible] and specific agents may [illegible] be large enough. The complete [illegible] of cancer [illegible] in very different than the [illegible] and [illegible] the latter, many lines of evidence indicate that cancer exposure [illegible] to diet [illegible]


Spectrum HoloByte
With all the voices of the TV cast!
STAR TREK
THE NEXT GENERATION

# *The Future:* New Ways of Measuring Diet and Physical Activity

# Multiple Administrations of Automated, Internet-Based 24-Hour Recalls



# 24-Hour Dietary Recalls (1)

- Used in national surveillance and as ‘reference instrument’
- With multiple administrations, likely more accurate than FFQ
- Too expensive for large scale studies

# 24-Hour Dietary Recalls (2)

- Automation and self-administration can make this a practical tool—via the internet

# Vision for ASA24

- Multiple 24HRs can be collected for minimal cost
  - Complete system for probing, coding, and calculation of intakes
  - Easily updated
- Adaptable to multiple languages and countries

Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://72.51.43.13/asa24/

NATIONAL CANCER INSTITUTE ASA24

Automated Self Administered 24-hour Dietary Recall

SIGN IN

Username: jane

Password: **********

Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://72.51.43.13/asa24/

NATIONAL CANCER INSTITUTE ASA24

Automated Self Administered 24-hour Dietary Recall

Yesterday's date was: Wednesday, Sep. 24, 2008

September 2008

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | | | | |

Remember, you will enter everything you had to eat and drink yesterday. According to my precise calculations, yesterday was Wednesday, Sep. 24, 2008. Please click the check mark button to continue.

Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://72.51.43.13/asa24/

NATIONAL CANCER INSTITUTE ASA24

Automated Self Administered 24-hour Dietary Recall

COMMANDS

ADD A MEAL | ADD A FOOD

DELETE A MEAL | DELETE A FOOD

EDIT MEAL | MOVE FOOD

COPY FOOD

EDIT FO

OOPS

ADD A MEAL

Name: Breakfast

Time: 7 | 00 | AM

Location: Home

Ate With: No one (ate alone)

TV On?: No

Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://72.51.43.13/asa24/

ASA24

Automated Self Administered 24-hour Dietary Recall

COMMANDS

ADD A MEAL

DELETE A MEAL

EDIT MEAL

ADD A FOOD

DELETE A FOOD

MOVE FOOD

COPY FOOD

EDIT FO

OOPS

DONE WITH ALL MEALS

MY SELECTIONS

Breakfast - 7:00 AM

Toast

Butter (real)

Tea (regular)

ADD FOODS

Browse

Search

Search for:

Enter se

ADD A MEAL

Name: Lunch

Time: 12 00 PM

Location: Work (not in cafeteria)

Ate With: Co-worker(s)

TV On?: No

Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://72.51.43.13/asa24/

NATIONAL CANCER INSTITUTE ASA24
Automated Self Administered 24-hour Dietary Recall

## COMMANDS

ADD A MEAL
DELETE A MEAL
EDIT MEAL

ADD A FOOD
DELETE A FOOD
MOVE FOOD
COPY FOOD
EDIT FOOD

OOPS
DONE WITH ALL MEALS

## MY SELECTIONS

Breakfast - 7:00 AM
Lunch - 12:00 PM

## ADD FOODS

Browse | Search

Search for: hamburr

- Hamburger Helper (Pizza P
- Hamburger Helper (Potato
- Hamburger Helper (Rice O
- Hamburger Helper (Salisbu
- Hamburger Helper (Spaghe
- Hamburger Helper (Stroga
- Hamburger Helper (Taco B
- Hamburger Helper (Three
- Hamburger Helper (unknov
- Hamburger on bread or bu
- Hamburger patty
- Jack-in-the-Box Hamburge
- Jack-in-the-Box Hamburge
- Jumbo Jack Hamburger
- Jumbo Jack Hamburger wi
- McDonald's Hamburger

Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://72.51.43.13/asa24/

**Hamburger on bread or bun : Amount of sandwich eaten?**

1/4 sandwich

1/2 sandwich

3/4 sa

1 sandwich

Less than 1/4 sandwich

More than 1 sandwich

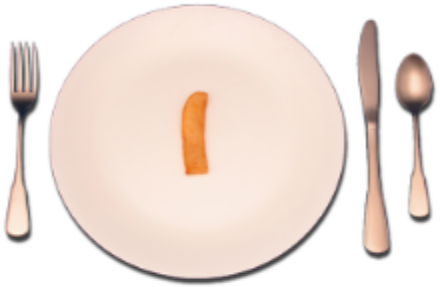
Don't know

Mozilla Firefox

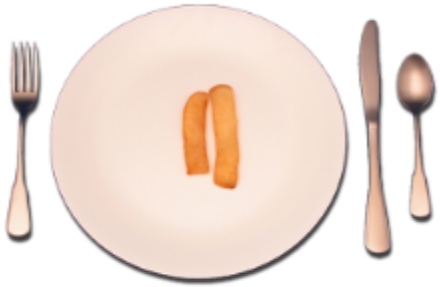
File Edit View History Bookmarks Tools Help

http://72.51.43.13/asa24/

**French fries (home prepared) : Amount eaten?**

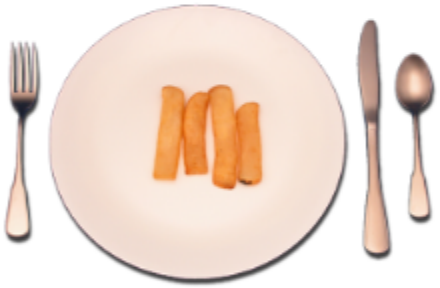


1/4 cup

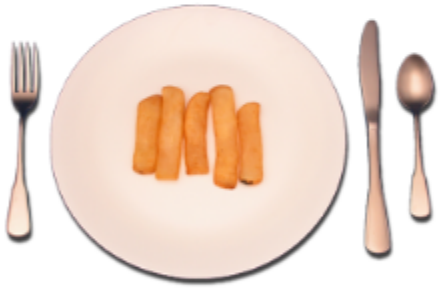


1/2 cup

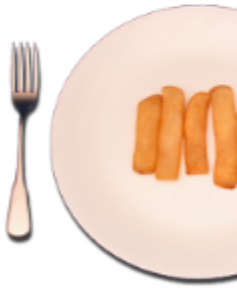
3/4



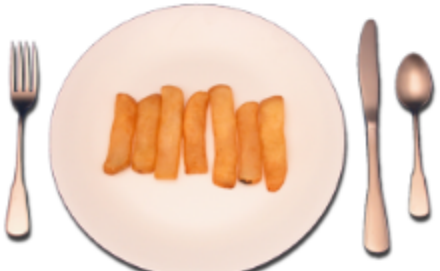
1 cup



1 1/4 cups



1 1/2



Less than

More than

Don't know

# ASA24
## Next Steps

- **Beta Testing**
- **Expected completion: Fall 2008**
- **Spanish version:  6 months later**

ACT24 - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites

Address http://pa24dev.westat.com/Project/Default.aspx

Google Go Bookmarks 5697 blocked Check AutoLink AutoFill Send to Settings

ACT 24

Logout

# Welcome to NCI ACT-24

The purpose of this brief questionnaire is to capture what activities you performed yesterday.

Please report activities that you engaged in for a minimun of 15 minutes from midnight yesterday to midnight today.

You do not need to remember the exact minute that you did the activity, but can round to the nearest 15 minutes.

Continue

NATIONAL CANCER INSTITUTE USA.gov

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Privacy Policy | Accessibility | Contact Us | Help

Done Local intranet

ACT 24 - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites

Address http://pa24dev.westat.com/Project/Activity.aspx

Google Go Bookmarks 5697 blocked Check AutoLink AutoFill Send to Settings

ACT 24

Logout

From the below list select the activity that you were doing at midnight yesterday 2/10/2008

Activity List

Please choose an activity below

**Quick Pick List**

- Sleep/Nap
- Bathe/Shower/Dress
- Prepare meals/snacks
- Eat meals/snacks
- Drive/Ride in a vehicle
- Work (occupational/volunteer)
- Walk
- Watch TV/Movies/Videos
- Shop (not on-line)
- Use the computer
- Talk on phone/in-person

**General Activity Categories**

- Personal Care/Essentials of Daily Living
- Routine Chores/Care Giving
- Quiet/Leisure Activities
- Home/Yard Maintenance
- Exercise and Sports
- Other

End Time

| | Yesterday, Sunday, February 10, 2008 |
|---|---|
| 12 AM | |
| 1 AM | |
| 2 AM | |
| 3 AM | |
| 4 AM | |
| 5 AM | |
| 6 AM | |
| 7 AM | |

Back Continue

Local intranet

ACT 24 - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites

Address http://pa24dev.westat.com/Project/Activity.aspx

Google Go Bookmarks 5697 blocked Check AutoLink AutoFill Send to Settings

Logout

Select the activity that you were doing at 1:30 PM yesterday, 2/10/2008

Please choose an activity below

**Quick Pick List**

- Sleep/Nap
- Bathe/Shower/Dress
- Prepare meals/snacks
- Eat meals/snacks
- Drive/Ride in a vehicle
- Work (occupational/volunteer)
- Walk
- Watch TV/Movies/Videos
- Shop (not on-line)
- Use the computer
- Talk on phone/in-person

**General Activity Categories**

- Personal Care/Essentials of Daily Living
- Routine Chores/Care Giving
- Quiet/Leisure Activities
- Home/Yard Maintenance
- Exercise and Sports
- Other

Walk

Activity List

Yesterday, Sunday, February 10, 2008

| | |
|---|---|
| 6 AM | |
| 7 AM | |
| 8 AM | Exercise and Sports / Bicycling (8:00 AM - 9:00 AM) |
| 9 AM | |
| 10 AM | Exercise and Sports / Running/Jogging (9:30 AM - 10:30 AM) |
| 11 AM | |
| 12 PM | Walk (12:15 PM - 1:30 PM) |
| 1 PM | |

Back Continue

National Cancer Institute USA.gov

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Local intranet

# Combined Data: New Statistical Approaches

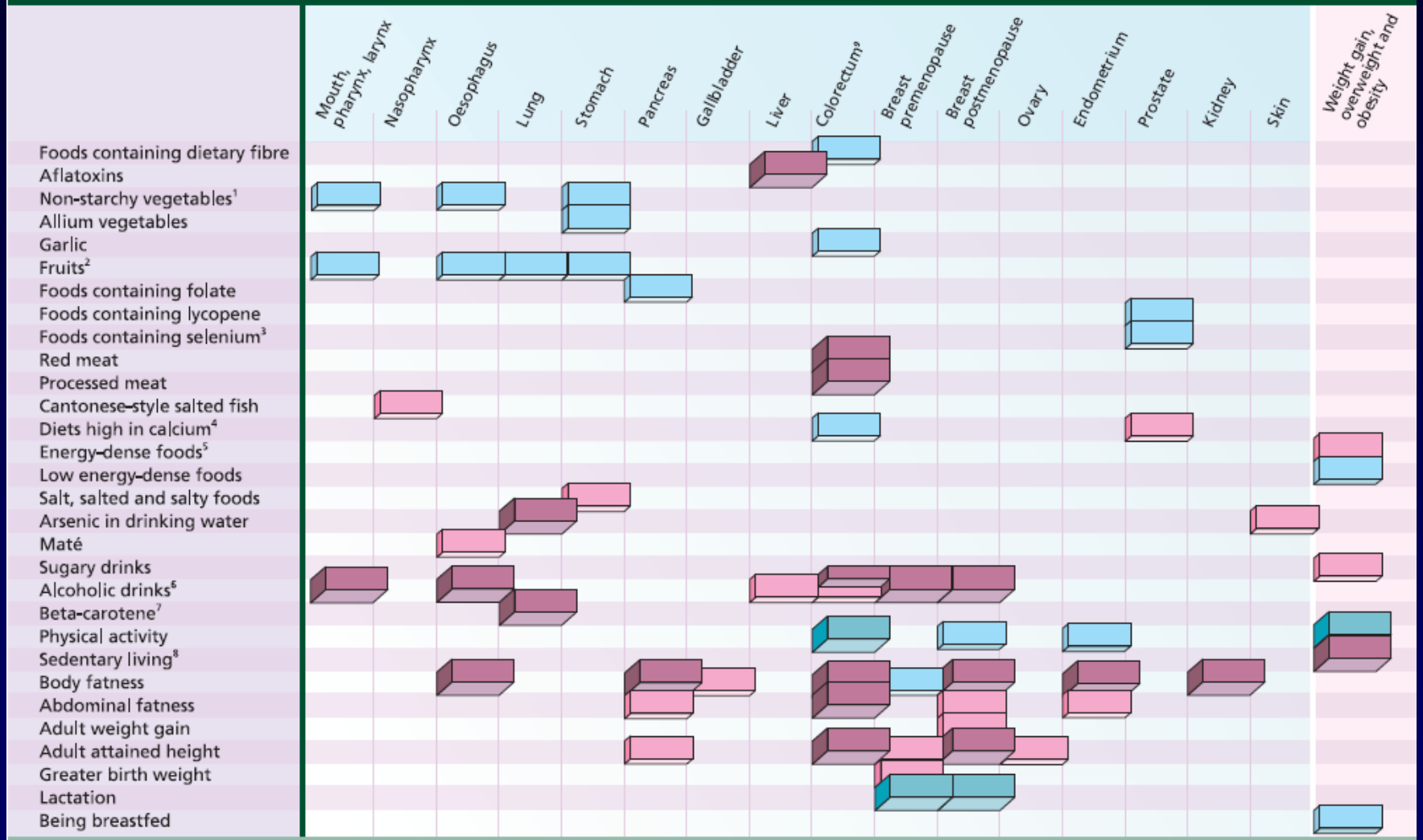
- Combining multiple recall with questionnaire data—frequency info may complement, esp. for episodic foods

# Promise?

- Incorporation of more intensive diet and PA assessment instruments into large prospective cohorts may help advance the nutritional epidemiology of cancer and other chronic diseases.

# Even in the Face of Uncertainty, We Know Enough to Make Recommendations

## Summary of 'convincing' and 'probable' judgements




**KEY**

- Convincing decreased risk
- Probable decreased risk
- Probable increased risk
- Convincing increased risk

[1] Includes evidence on foods containing carotenoids for mouth, pharynx, larynx; foods containing beta-carotene for oesophagus; foods containing vitamin C for oesophagus

[2] Includes evidence on foods containing carotenoids for mouth, pharynx, larynx and lung; foods containing beta-carotene for oesophagus; foods containing vitamin C for oesophagus

[3] Includes evidence from supplements for prostate

[4] Evidence is from milk and studies using supplements for colorectum

[5] Includes 'fast foods'

[6] Convincing harm for men and probable harm for women for colorectum

[7] The evidence is derived from studies using supplements for lung

[8] Includes evidence on televison viewing

[9] Judgement for physical activity applies to colon and not rectum

World Cancer Research Fund — American Institute for Cancer Research

CHAPTER 12

# Public health goals and personal recommendations

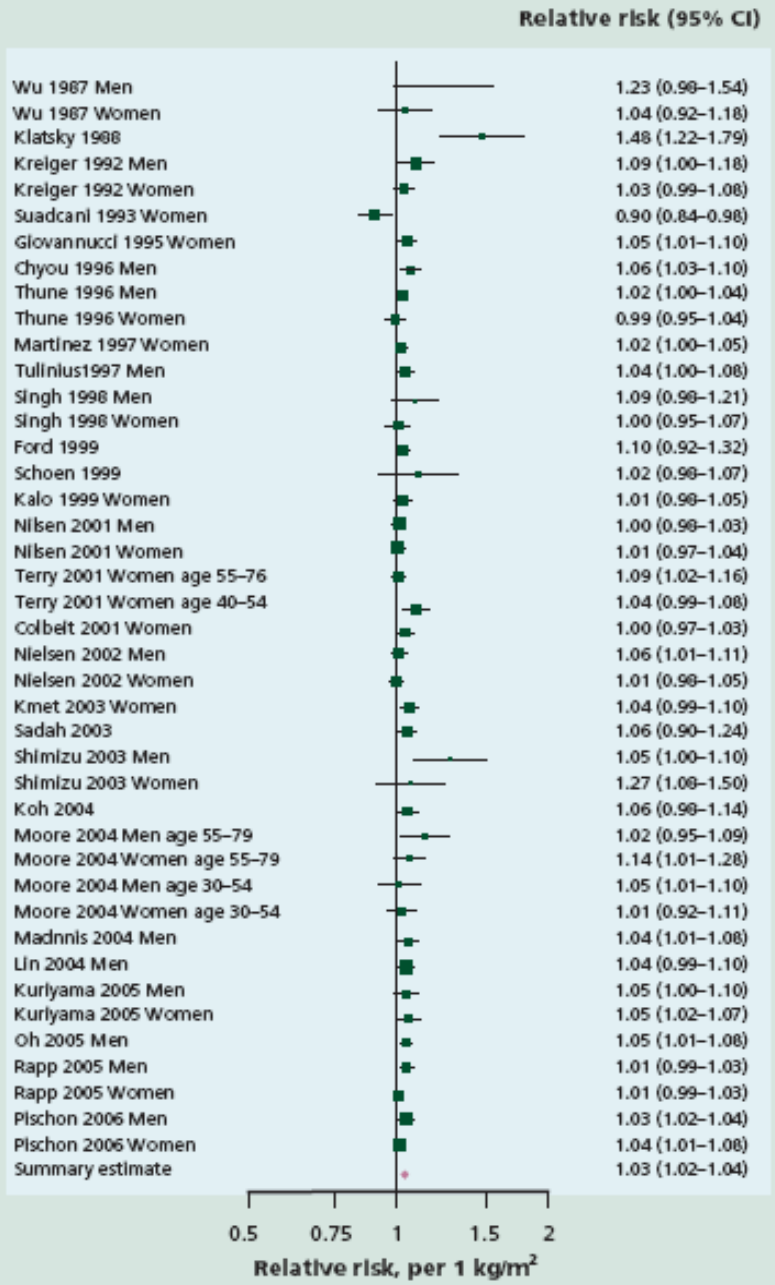
The evidence that overweight and obesity increase the risk of a number of cancers is now even more impressive than in the mid-1990s. Since that time, rates of overweight and obesity, in adults as well as in children, have greatly increased in most countries.

## BODY FATNESS, AND THE RISK OF CANCER

In the judgement of the Panel, the factors listed below modify the risk of cancer. Judgements are graded according to the strength of the evidence.

| | DECREASES RISK | | INCREASES RISK | |
|---|---|---|---|---|
| | Exposure | Cancer site | Exposure | Cancer site |
| **Convincing** | | | **Body fatness** | **Oesophagus[1]**<br>**Pancreas**<br>**Colorectum**<br>**Breast (postmenopause)**<br>**Endometrium**<br>**Kidney** |
| | | | **Abdominal fatness** | **Colorectum** |
| **Probable** | **Body fatness** | **Breast (premenopause)** | **Body fatness** | **Gallbladder[2]** |
| | | | **Abdominal fatness** | **Pancreas**<br>**Breast (postmenopause)**<br>**Endometrium** |
| | | | **Adult weight gain** | **Breast (postmenopause)** |
| Limited — suggestive | | | Body fatness | Liver |
| | | | Low body fatness | Lung |
| **Substantial effect on risk unlikely** | None identified | | | |

**Figure 6.1.6** BMI and colorectal cancer; cohort studies



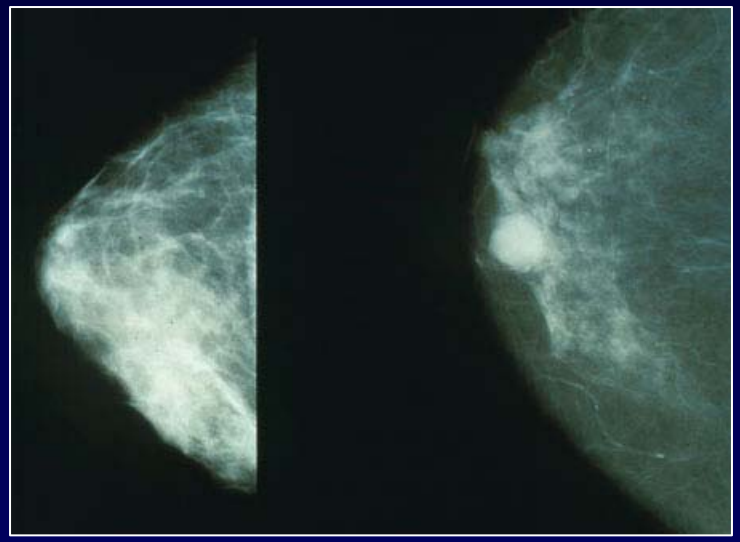


**Figure 6.1.11** BMI and postmenopausal breast cancer; cohort studies

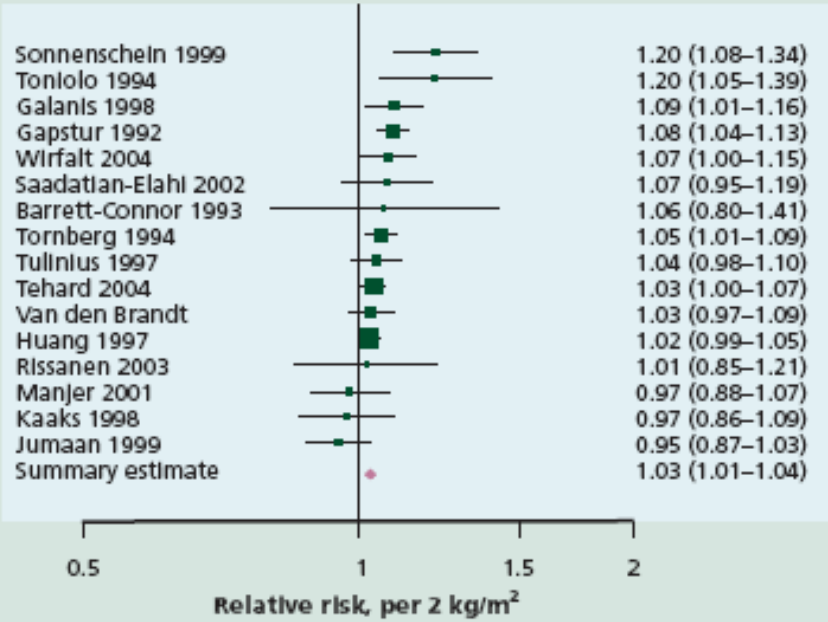
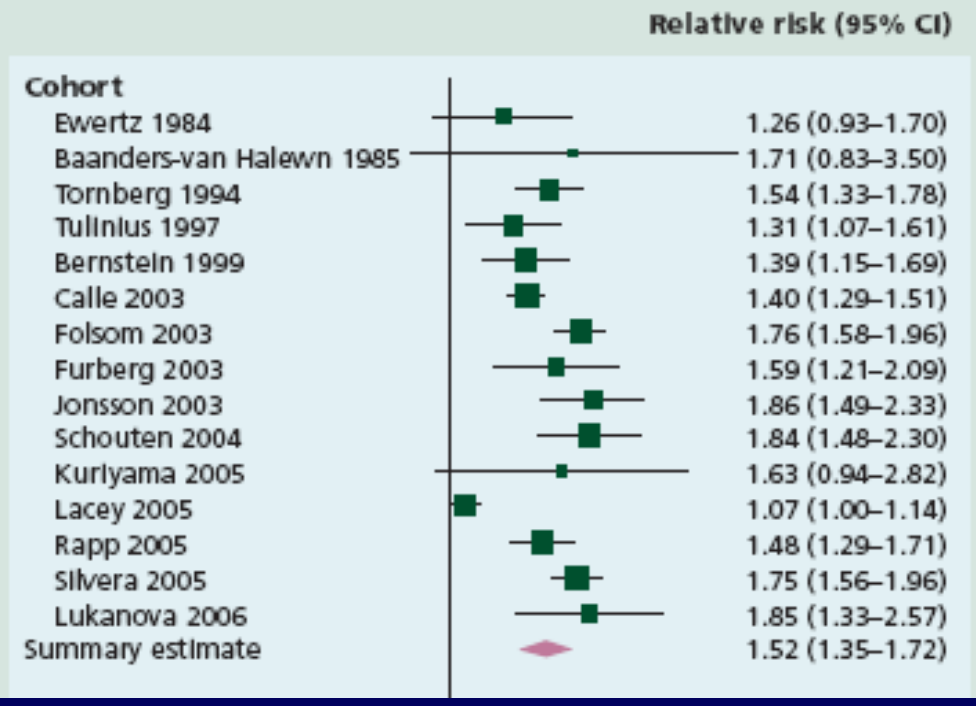


**Figure 6.1.17** BMI and endometrial cancer; cohort and case-control studies



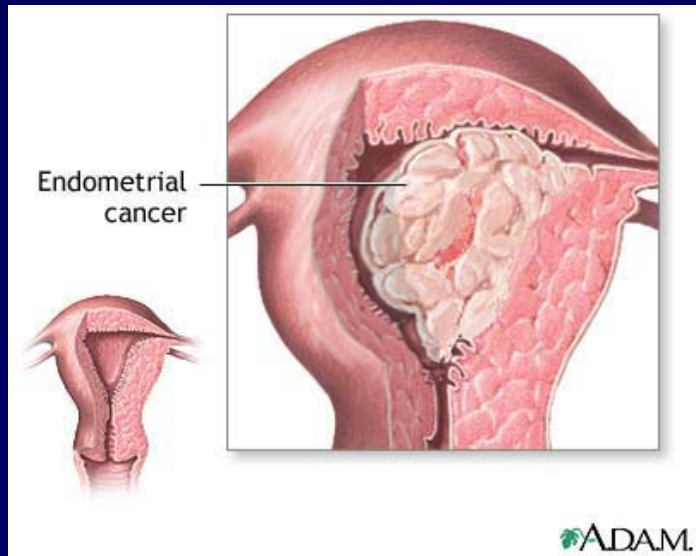
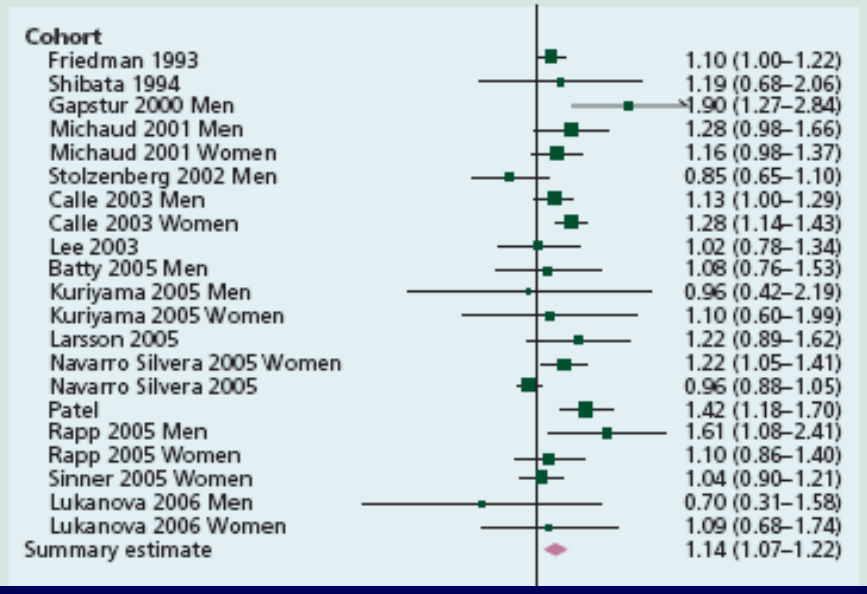



**Figure 6.1.4** BMI and pancreatic cancer; cohort [redacted] studies



## RECOMMENDATION 1

### BODY FATNESS

**Be as lean as possible within the normal range[1] of body weight**

PUBLIC HEALTH GOALS

Median adult body mass index (BMI) to be between 21 and 23, depending on the normal range for different populations[2]

The proportion of the population that is overweight or obese to be no more than the current level, or preferably lower, in 10 years

PERSONAL RECOMMENDATIONS

Ensure that body weight through childhood and adolescent growth projects[3] towards the lower end of the normal BMI range at age 21

Maintain body weight within the normal range from age 21

Avoid weight gain and increases in waist circumference throughout adulthood

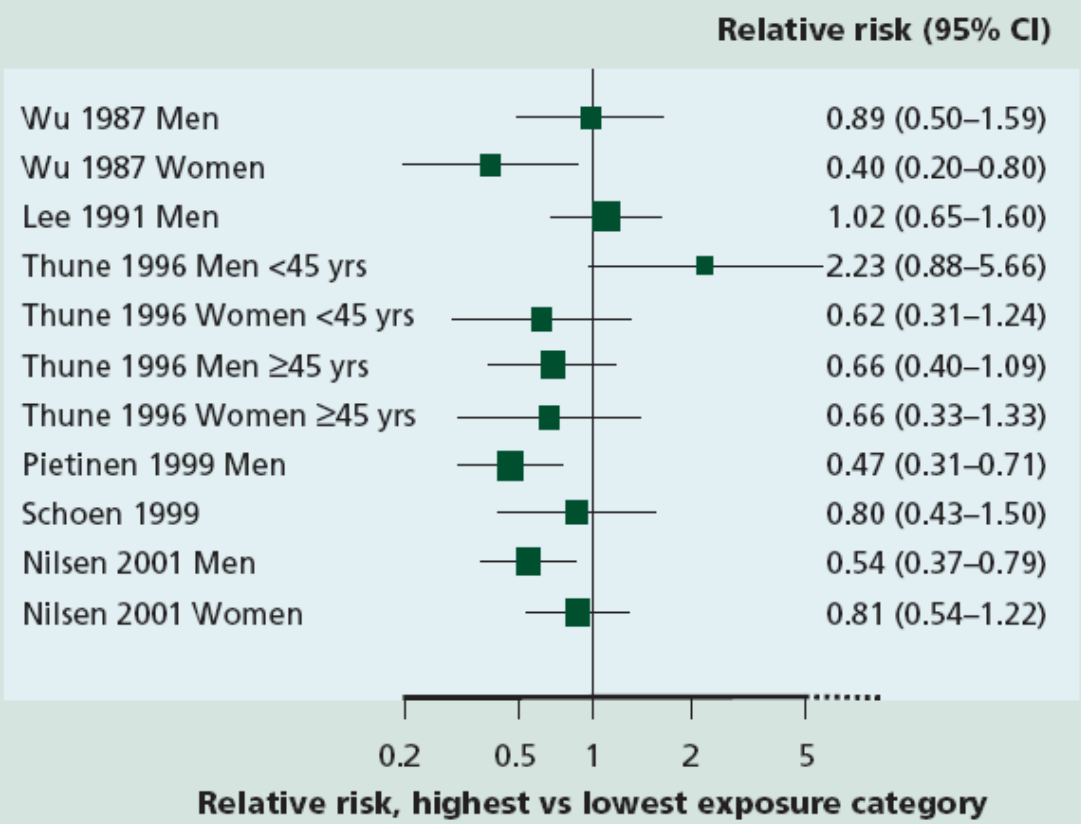
The evidence that physical activity of all types protects against cancer and also against obesity, and therefore indirectly those cancers whose risk is increased by obesity, has continued to accumulate since the early 1990s.

# PHYSICAL ACTIVITY, AND THE RISK OF CANCER

In the judgement of the Panel, physical activity[1] modifies the risk of the following cancers. Judgements are graded according to the strength of the evidence.

| | DECREASES RISK | INCREASES RISK |
|---|---|---|
| **Convincing** | **Colon[2]** | |
| **Probable** | **Breast (postmenopause)**<br>**Endometrium** | |
| Limited — suggestive | Lung<br>Pancreas<br>Breast (premenopause) | |
| **Substantial effect on risk unlikely** | None identified | |

**Figure 5.4.1** Total physical activity and colorectal cancer; cohort studies



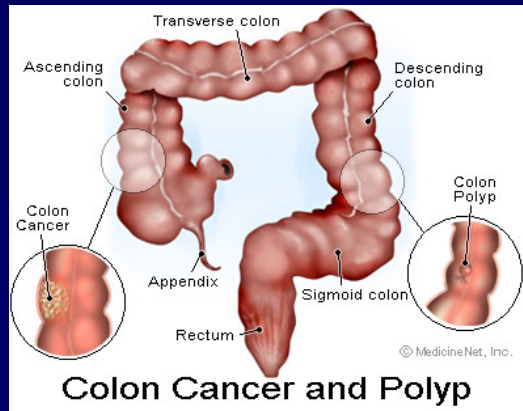
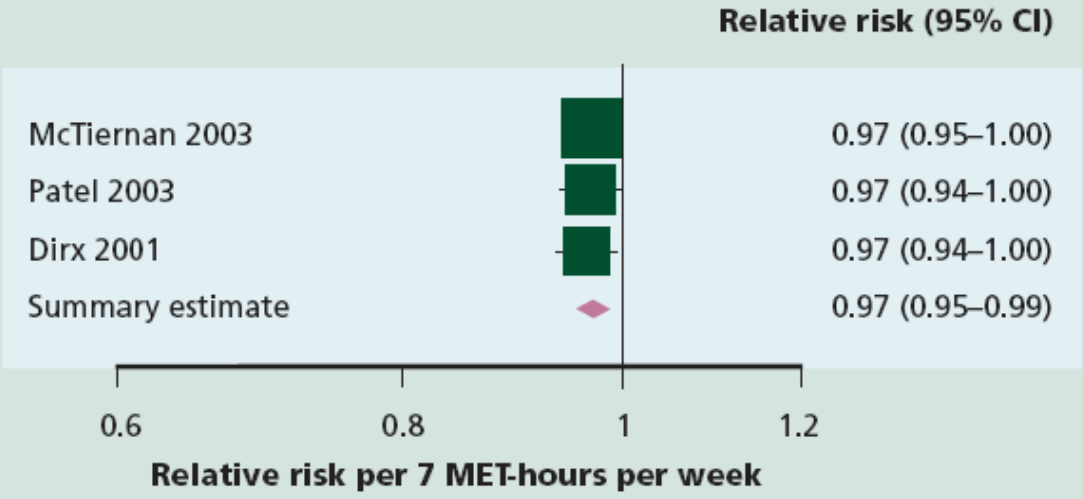



**Figure 5.4.6** Recreational physical activity and postmenopausal breast cancer; cohort studies



RECOMMENDATION 2

## PHYSICAL ACTIVITY

**Be physically active as part of everyday life**

PUBLIC HEALTH GOALS

The proportion of the population that is sedentary[1] to be halved every 10 years

Average physical activity levels (PALs)[1] to be above 1.6

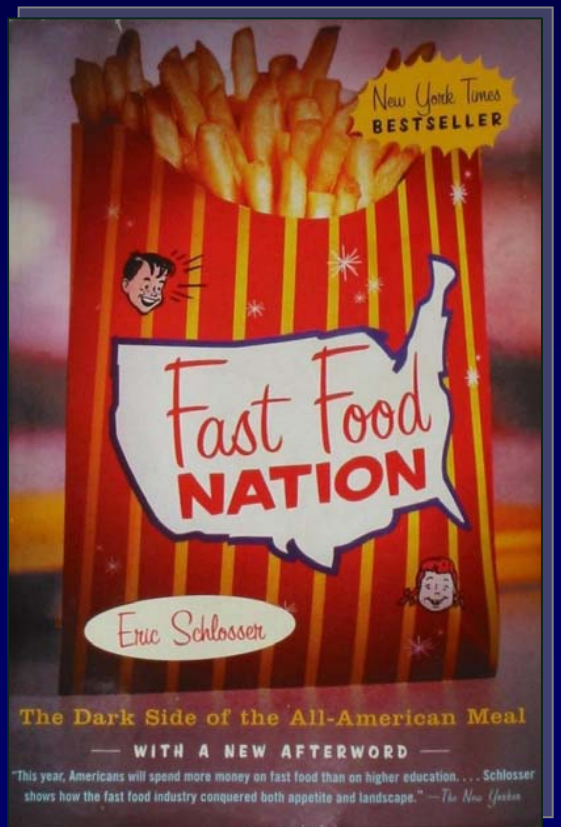
PERSONAL RECOMMENDATIONS

Be moderately physically active, equivalent to brisk walking,[2] for at least 30 minutes every day

As fitness improves, aim for 60 minutes or more of moderate, or for 30 minutes or more of vigorous, physical activity every day[2 3]

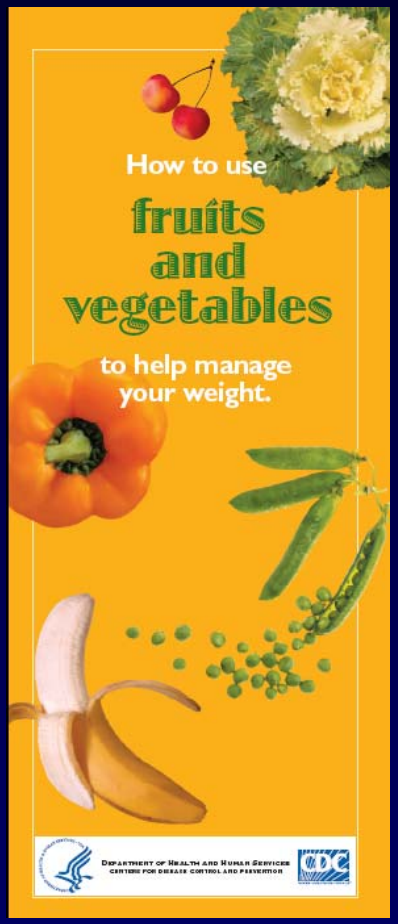
Limit sedentary habits such as watching television

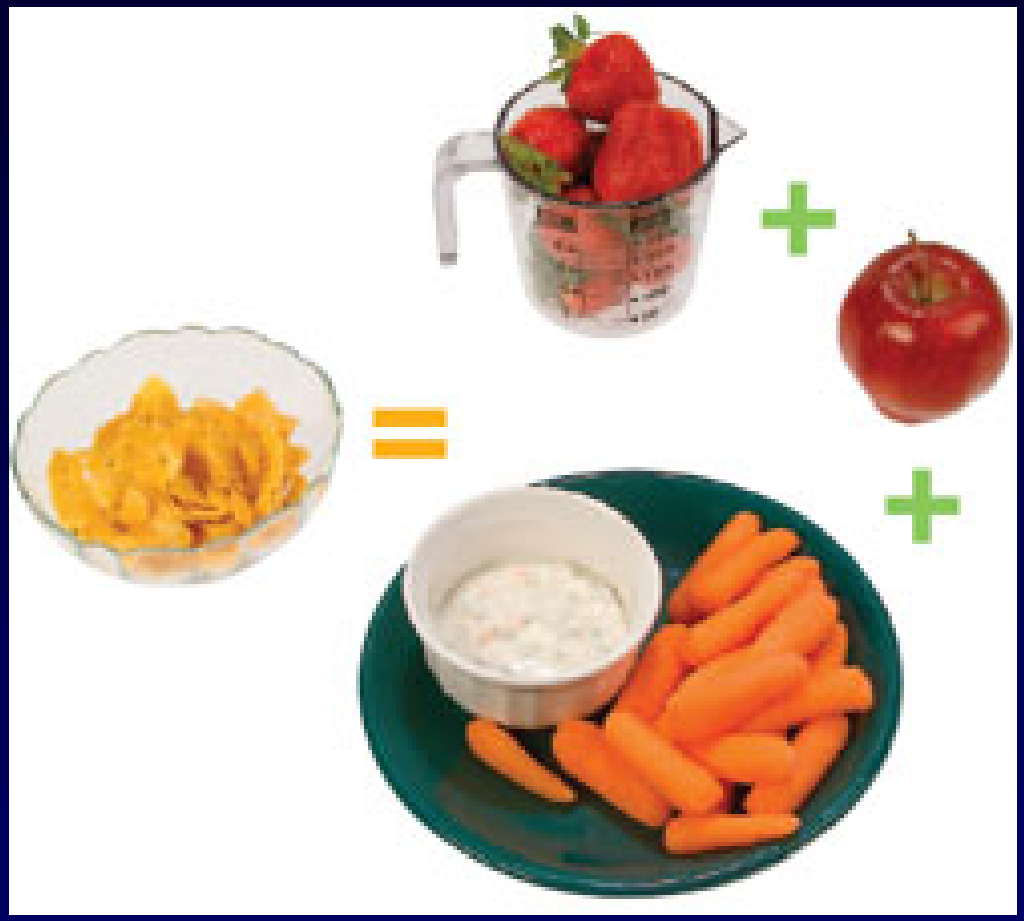
Evidence shows that foods and diets that are high in energy, particularly those that are highly processed, and sugary drinks, increase the risk of overweight and obesity. Some foods low in energy density probably protect against some cancers.



**A quarter-pound cheeseburger, large fries and a 16 oz. soda *provide:***

- 1,166 calories
- 51 g fat
- 95 mg cholesterol
- 1,450 mg sodium



Substitute one or two of these options for the chips, and you will have a satisfying snack with fewer calories.

## RECOMMENDATION 3

# FOODS AND DRINKS THAT PROMOTE WEIGHT GAIN

**Limit consumption of energy-dense foods[1]**
**Avoid sugary drinks[2]**

PUBLIC HEALTH GOALS

Average energy density of diets[3] to be lowered towards 125 kcal per 100 g

Population average consumption of sugary drinks[2] to be halved every 10 years

PERSONAL RECOMMENDATIONS

Consume energy-dense foods[1 4] sparingly

Avoid sugary drinks[2]

Consume 'fast foods'[5] sparingly, if at all

The evidence that diets high in vegetables and fruits protect against cancer is overall less compelling than in the mid-1990s. However, vegetables and fruits, and other foods containing dietary fibre, probably protect against a number of cancers.

## VEGETABLES,[1] FRUITS,[1] PULSES (LEGUMES), NUTS, SEEDS, HERBS, SPICES, AND THE RISK OF CANCER

In the judgement of the Panel, the factors listed below modify the risk of cancer. Judgements are graded according to the strength of the evidence.

| | DECREASES RISK | | INCREASES RISK | |
|---|---|---|---|---|
| | Exposure | Cancer site | Exposure | Cancer site |
| **Convincing** | | | | |
| **Probable** | Non-starchy vegetables[1] | Mouth, pharynx, larynx<br>Oesophagus<br>Stomach | | |
| | Allium vegetables[1] | Stomach | | |
| | Garlic[1] | Colorectum | | |
| | Fruits[1] | Mouth, pharynx, larynx<br>Oesophagus<br>Lung<br>Stomach | | |
| | Foods containing folate[2] | Pancreas | | |
| | Foods containing carotenoids[2] | Mouth, pharynx, larynx<br>Lung | | |
| | Foods containing beta-carotene[2] | Oesophagus | | |
| | Foods containing lycopene[2 3] | Prostate | | |
| | Foods containing vitamin C[2 4] | Oesophagus | | |
| | Foods containing selenium[2 5] | Prostate | | |

**Figure 4.2.8** Non-starchy vegetables and stomach cancer; cohort and case-control studies

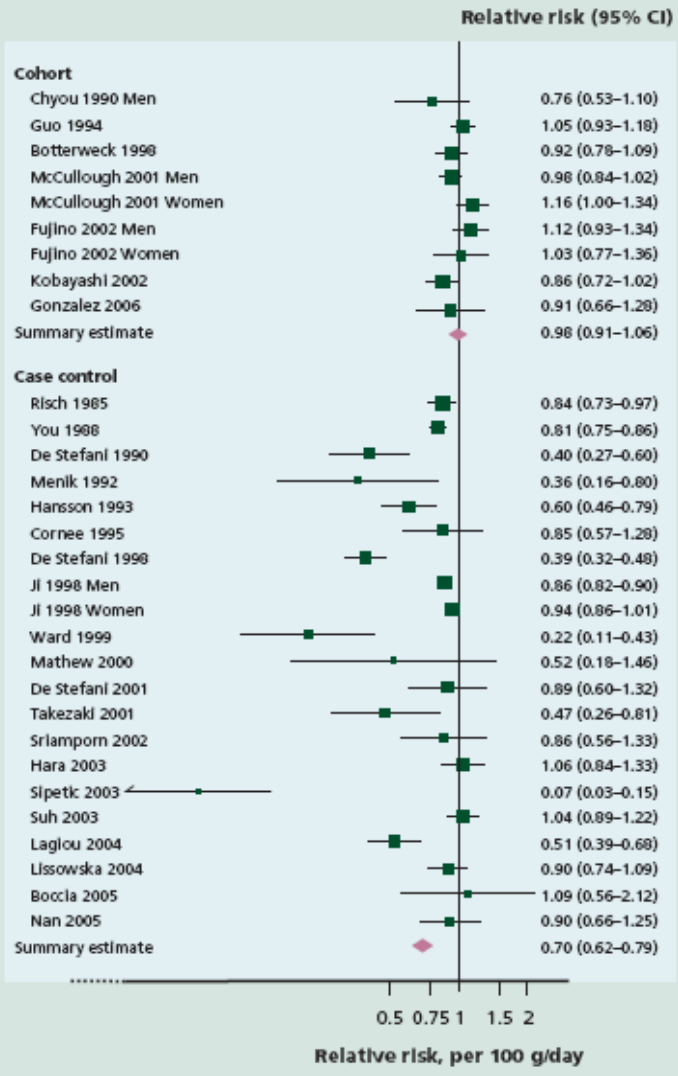
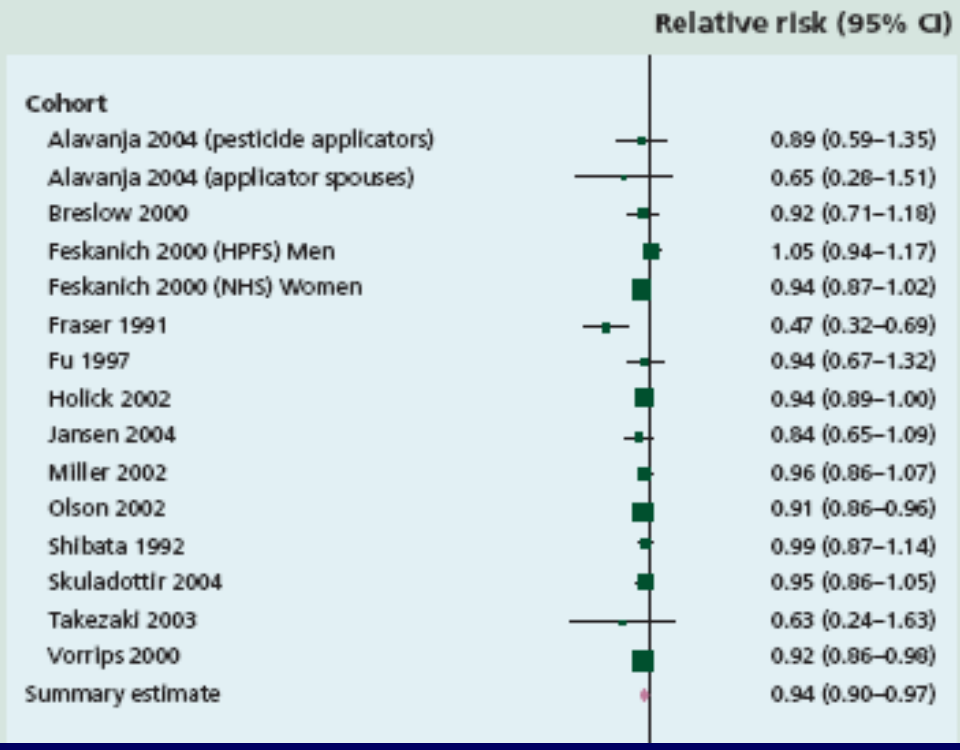


**Figure 4.2.25** Fruits and lung cancer; cohort studies



## CEREALS (GRAINS), STARCHY ROOTS AND TUBERS, PLANTAINS, AND THE RISK OF CANCER

In the judgement of the Panel, the factors listed below modify the risk of cancer. Judgements are graded according to the strength of the evidence.

| | DECREASES RISK | | INCREASES RISK | |
|---|---|---|---|---|
| | Exposure | Cancer site | Exposure | Cancer site |
| **Convincing** | | | **Aflatoxins[1]** | **Liver** |
| **Probable** | **Foods containing dietary fibre[2]** | **Colorectum** | | |
| Limited — suggestive | Foods containing dietary fibre[2] | Oesophagus | | |
| **Substantial effect on risk unlikely** | None identified | | | |

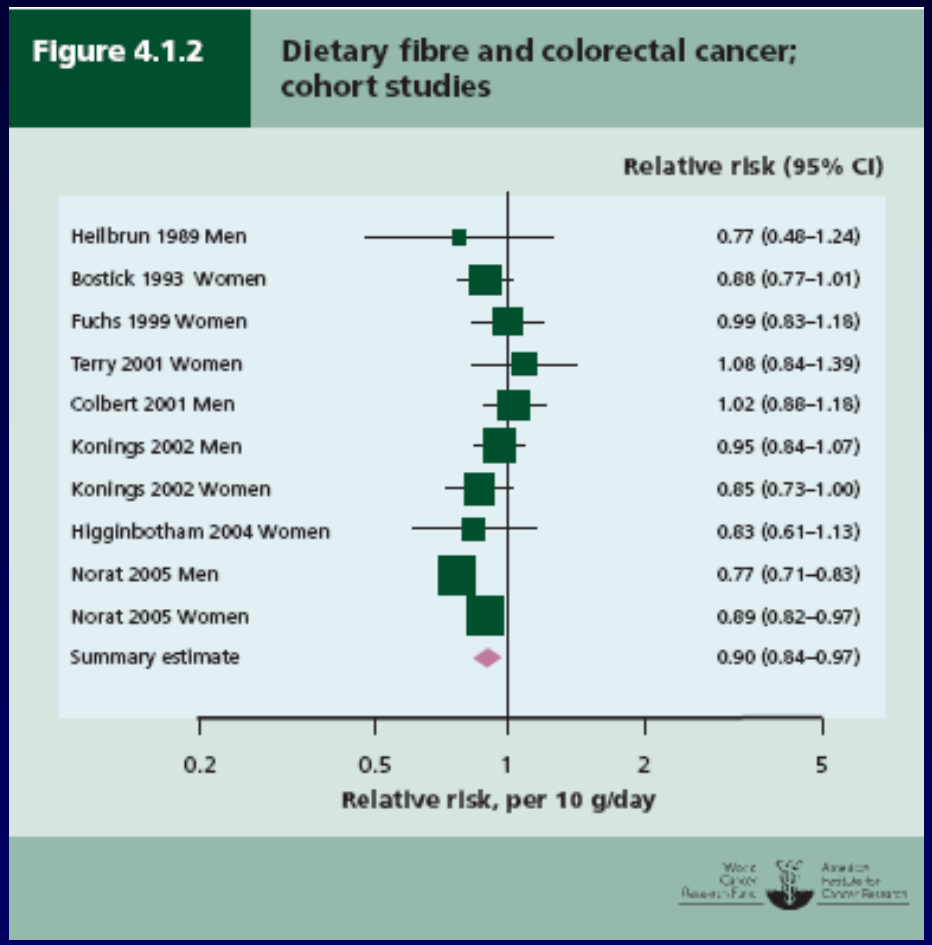
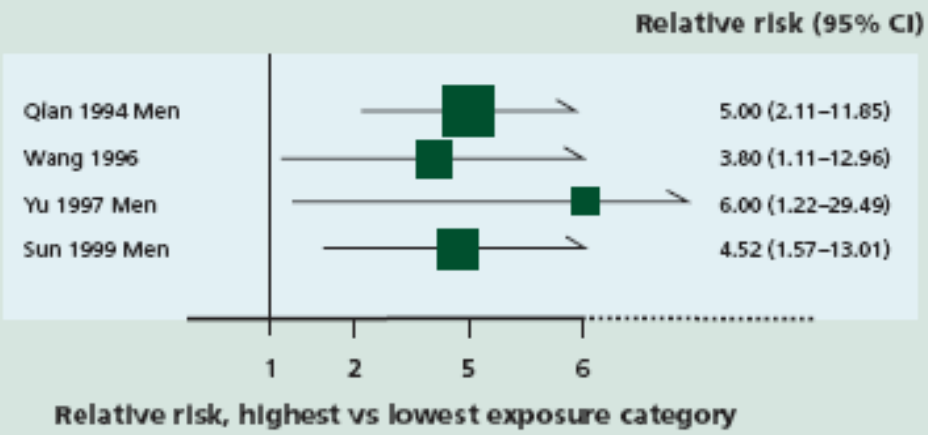


Figure 4.1.2
Dietary fibre and colorectal cancer; cohort studies
Relative risk (95% CI)
Heilbrun 1989 Men
0.77 (0.48–1.24)
Bostick 1993 Women
0.88 (0.77–1.01)
Fuchs 1999 Women
0.99 (0.83–1.18)
Terry 2001 Women
1.08 (0.84–1.39)
Colbert 2001 Men
1.02 (0.88–1.18)
Konings 2002 Men
0.95 (0.84–1.07)
Konings 2002 Women
0.85 (0.73–1.00)
Higginbotham 2004 Women
0.83 (0.61–1.13)
Norat 2005 Men
0.77 (0.71–0.83)
Norat 2005 Women
0.89 (0.82–0.97)
Summary estimate
0.90 (0.84–0.97)
0.2
0.5
1
2
5
Relative risk, per 10 g/day

**Figure 4.1.3** Aflatoxins and liver cancer; cohort studies



RECOMMENDATION 4

## PLANT FOODS

### Eat mostly foods of plant origin

PUBLIC HEALTH GOALS

Population average consumption of non-starchy[1] vegetables and of fruits to be at least 600 g (21 oz) daily[2]

Relatively unprocessed cereals (grains) and/or pulses (legumes), and other foods that are a natural source of dietary fibre, to contribute to a population average of at least 25 g non-starch polysaccharide daily

PERSONAL RECOMMENDATIONS

Eat at least five portions/servings (at least 400 g or 14 oz) of a variety[2] of non-starchy vegetables and of fruits every day

Eat relatively unprocessed cereals (grains) and/or pulses (legumes) with every meal[3]

Limit refined starchy foods

People who consume starchy roots or tubers[4] as staples also to ensure intake of sufficient non-starchy vegetables, fruits, and pulses (legumes)

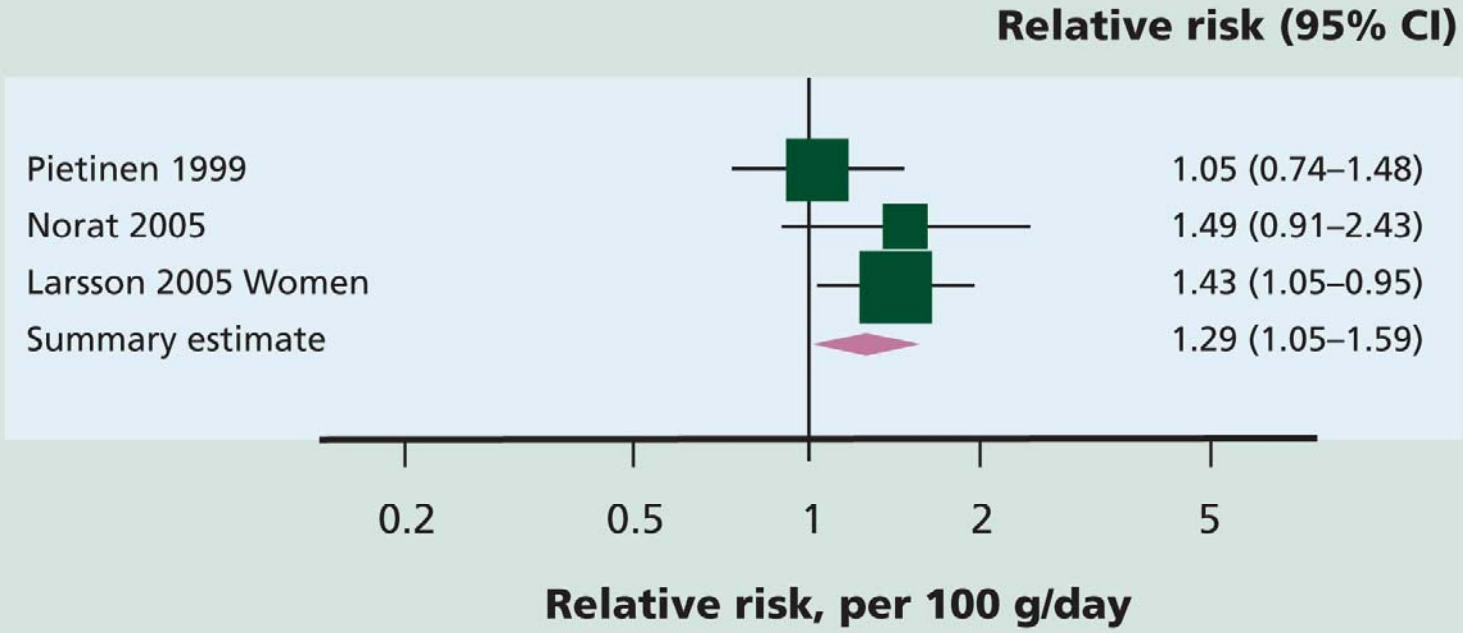
The evidence that red meat, and particularly processed meat, is a cause of colorectal cancer is stronger now than it was in the mid-1990s.

## MEAT, POULTRY, FISH, EGGS, AND THE RISK OF CANCER

In the judgement of the Panel, the factors listed below modify the risk of cancer. Judgements are graded according to the strength of the evidence.

| | DECREASES RISK | | INCREASES RISK | |
|---|---|---|---|---|
| | **Exposure** | **Cancer site** | **Exposure** | **Cancer site** |
| **Convincing** | | | **Red meat[1]** | **Colorectum** |
| | | | **Processed meat[2]** | **Colorectum** |
| **Probable** | | | **Cantonese-style salted fish[3]** | **Nasopharynx** |
| Limited — suggestive | Fish | Colorectum | Red meat[1] | Oesophagus<br>Lung<br>Pancreas<br>Endometrium |
| | Foods containing vitamin D[4 7] | Colorectum | Processed meat[2] | Oesophagus<br>Lung<br>Stomach<br>Prostate |
| | | | Foods containing iron[4 5] | Colorectum |
| | | | Smoked foods[6] | Stomach |
| | | | Grilled (broiled) or barbecued (charbroiled) animal foods[6] | Stomach |
| **Substantial effect on risk unlikely** | None identified | | | |

## Red meat and colorectal cancer; cohort studies

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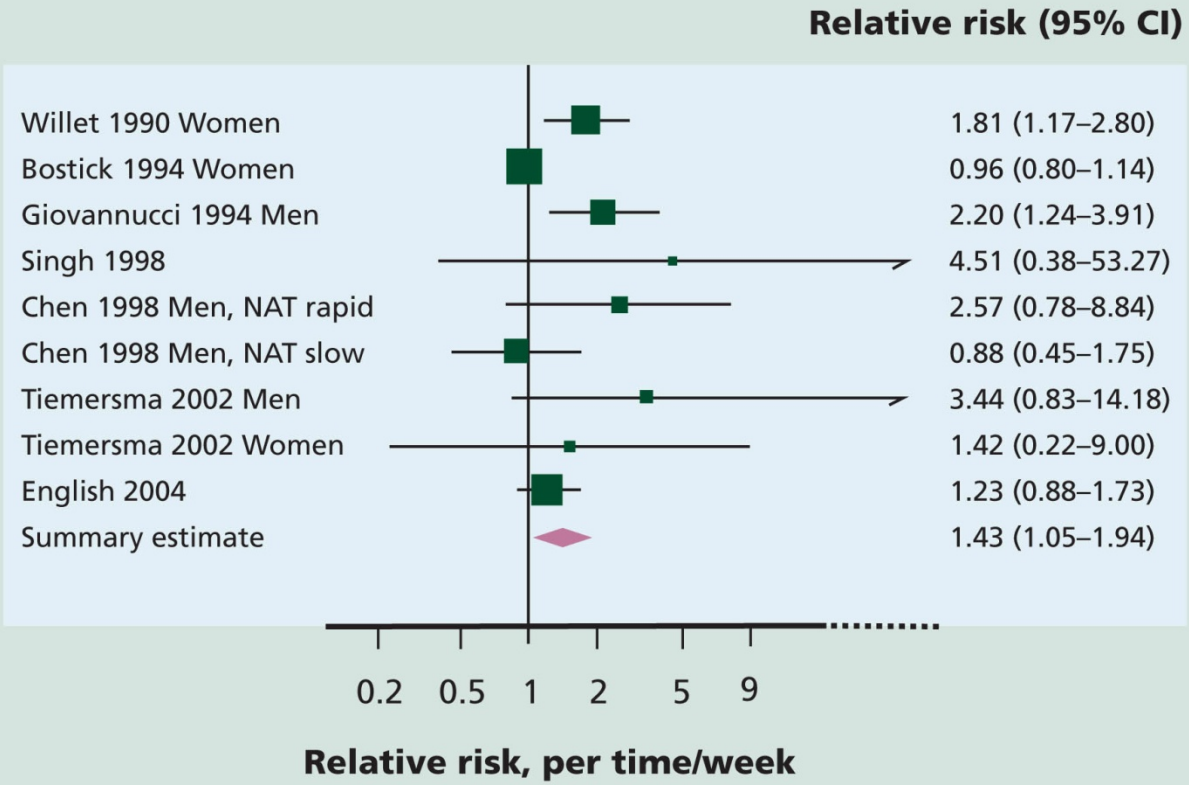
**CONVINCING**

## Red meat and colorectal cancer; cohort studies

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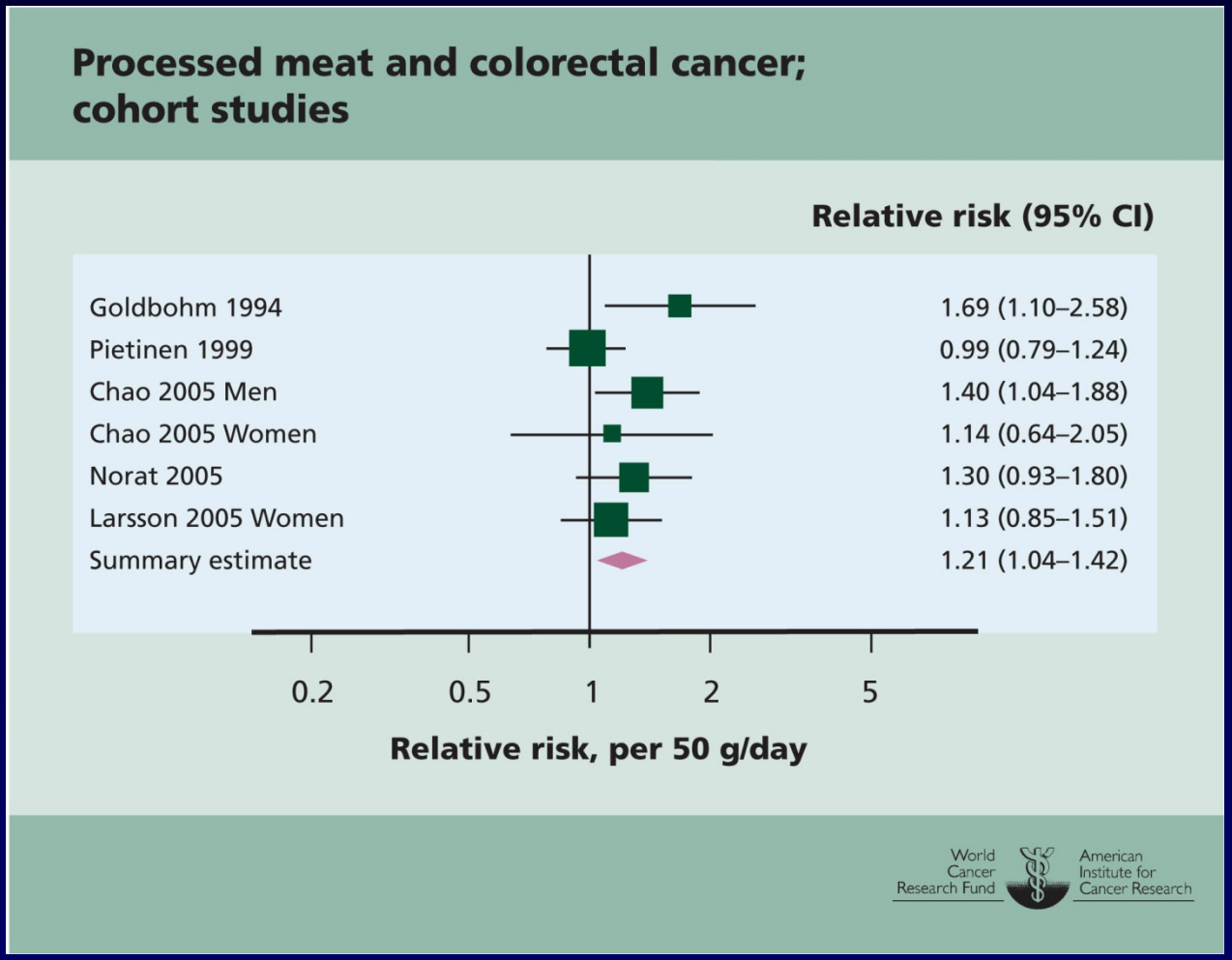
**CONVINCING**




**'Data do not show any level of intake that can confidently be shown not to be associated with risk.'**

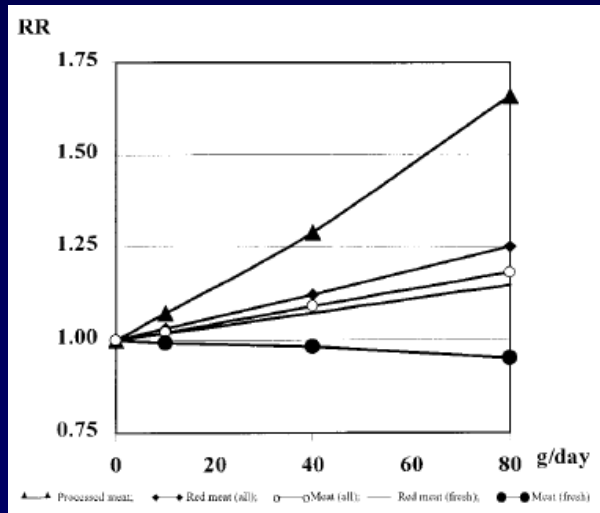
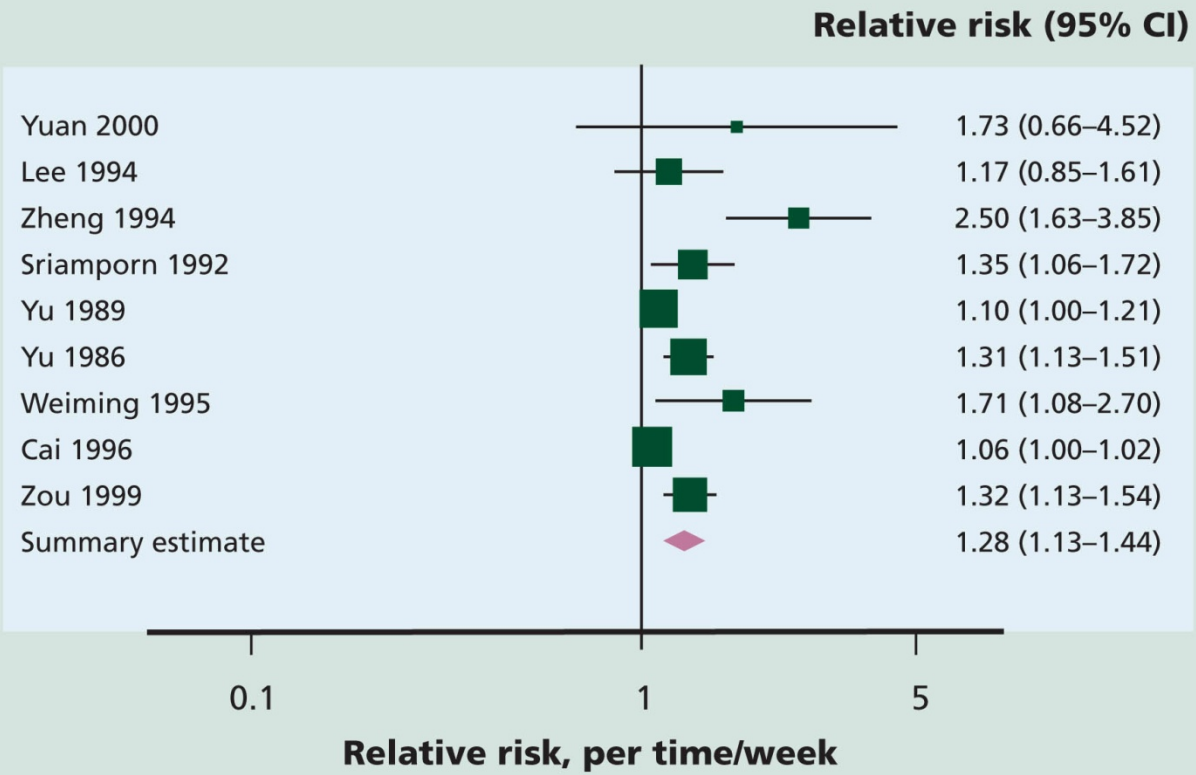



FIGURE 4 – Dose-response analysis of relative risk of colorectal cancer for meat consumption.

**CONVINCING**

## Salted fish and nasopharyngeal cancer; case control

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**PROBABLE**

## MILK, DAIRY PRODUCTS, AND THE RISK OF CANCER

In the judgement of the Panel, the factors listed below modify the risk of cancer. Judgements are graded according to the strength of the evidence.

| | DECREASES RISK | | INCREASES RISK | |
|---|---|---|---|---|
| | **Exposure** | **Cancer site** | **Exposure** | **Cancer site** |
| **Convincing** | | | | |
| **Probable** | **Milk[1 4]** | **Colorectum** | **Diets high in calcium[2 3]** | **Prostate** |
| Limited — suggestive | Milk[1] | Bladder | Milk and dairy products[2]<br>Cheese[4] | Prostate<br>Colorectum |
| **Substantial effect on risk unlikely** | None identified | | | |

**CONFLICTING PROBABLE** ⇨ **NO RECOMMENDATION for MILK, CHEESE, OTHER DAIRY PRODUCTS**

RECOMMENDATION 5

## ANIMAL FOODS

**Limit intake of red meat[1] and avoid processed meat[2]**

PUBLIC HEALTH GOAL

Population average consumption of red meat to be no more than 300 g (11 oz) a week, very little if any of which to be processed

PERSONAL RECOMMENDATION

People who eat red meat[1] to consume less than 500 g (18 oz) a week, very little if any to be processed[2]

RECOMMENDATION 5

## ANIMAL FOODS

**Limit intake of red meat[1] and avoid processed meat[2]**

PUBLIC HEALTH GOAL

Population average consumption of red meat to be no more than 300 g (11 oz) a week, very little if any of which to be processed

PERSONAL RECOMMENDATION

People who eat red meat[1] to consume less than 500 g (18 oz) a week, very little if any to be processed[2]

- **Meat is valuable source of nutrients (protein, iron, zinc, vitamin B12)**
- **For those eating flesh foods, amount of red meat can be limited by choosing poultry, fish.**

# Quantitative Recommendations for Red Meat Intake

- ***Individual goal*** **= 500 g/week**
  - **There is a continuum of increasing risk with increased intake; this is level at which the increased risk becomes statistically significant**
- ***Population goal*** **= 300 g/week**
  - **This is the estimated average intake for a population distribution within which 500 mg/week is at the upper range**

The evidence that all types of alcoholic drink are a cause of a number of cancers is now stronger than it was in the mid-1990s.

## ALCOHOLIC DRINKS, AND THE RISK OF CANCER

In the judgement of the Panel, the factors listed below modify the risk of cancer. Judgements are graded according to the strength of the evidence.

| | DECREASES RISK | | INCREASES RISK | |
|---|---|---|---|---|
| | Exposure | Cancer site | Exposure | Cancer site |
| **Convincing** | | | **Alcoholic drinks** | **Mouth, pharynx and larynx**<br>**Oesophagus**<br>**Colorectum (men)[1]**<br>**Breast (pre- and postmenopause)** |
| **Probable** | | | **Alcoholic drinks** | **Liver[2]**<br>**Colorectum (women)[1]** |
| Limited — suggestive | | | | |
| **Substantial effect on risk unlikely** | Alcoholic drinks (adverse effect): kidney[3] | | | |

**Figure 4.8.2** Alcoholic drinks and mouth, pharynx, and larynx cancer; cohort and case-control studies

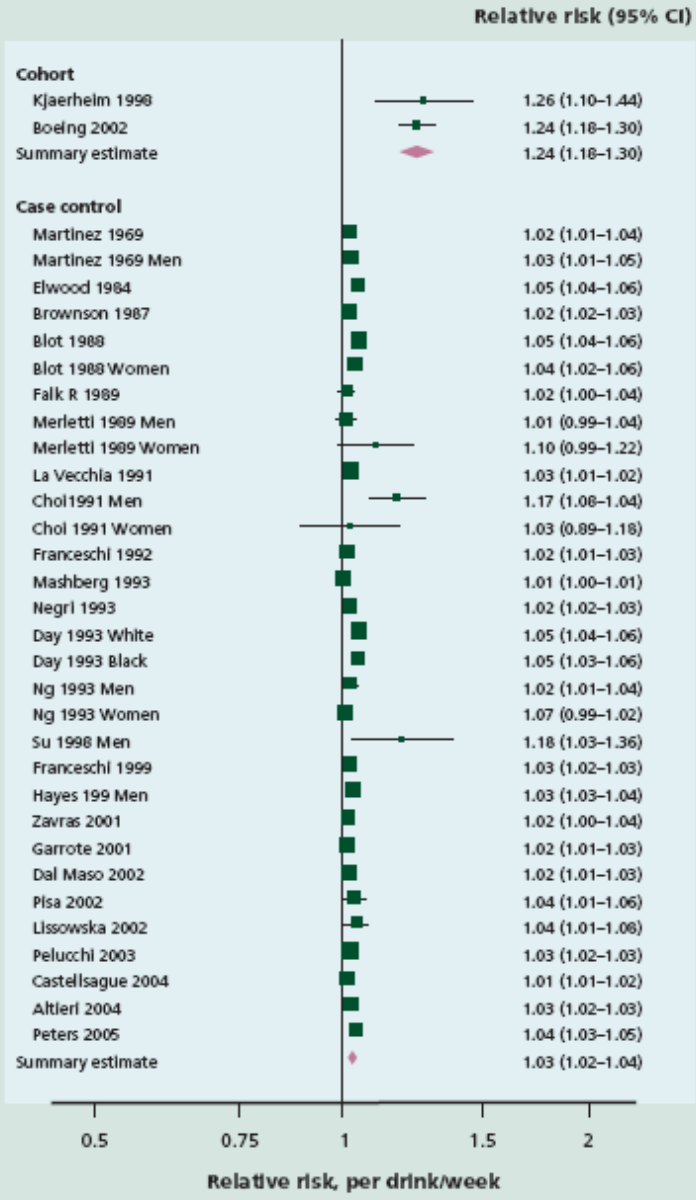



**Figure 4.8.6** Alcoholic drinks and oesophageal cancer; cohort and case-control studies

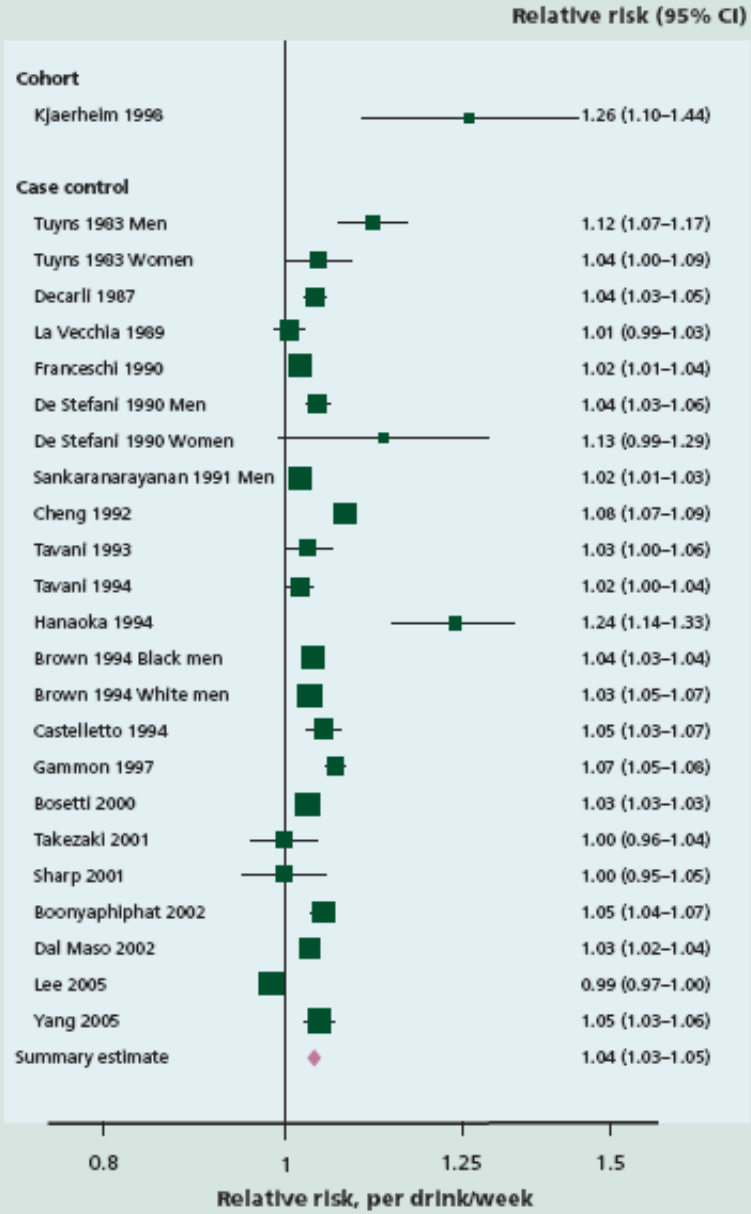


**Figure 4.8.10** **Ethanol and colon cancer; cohort studies**

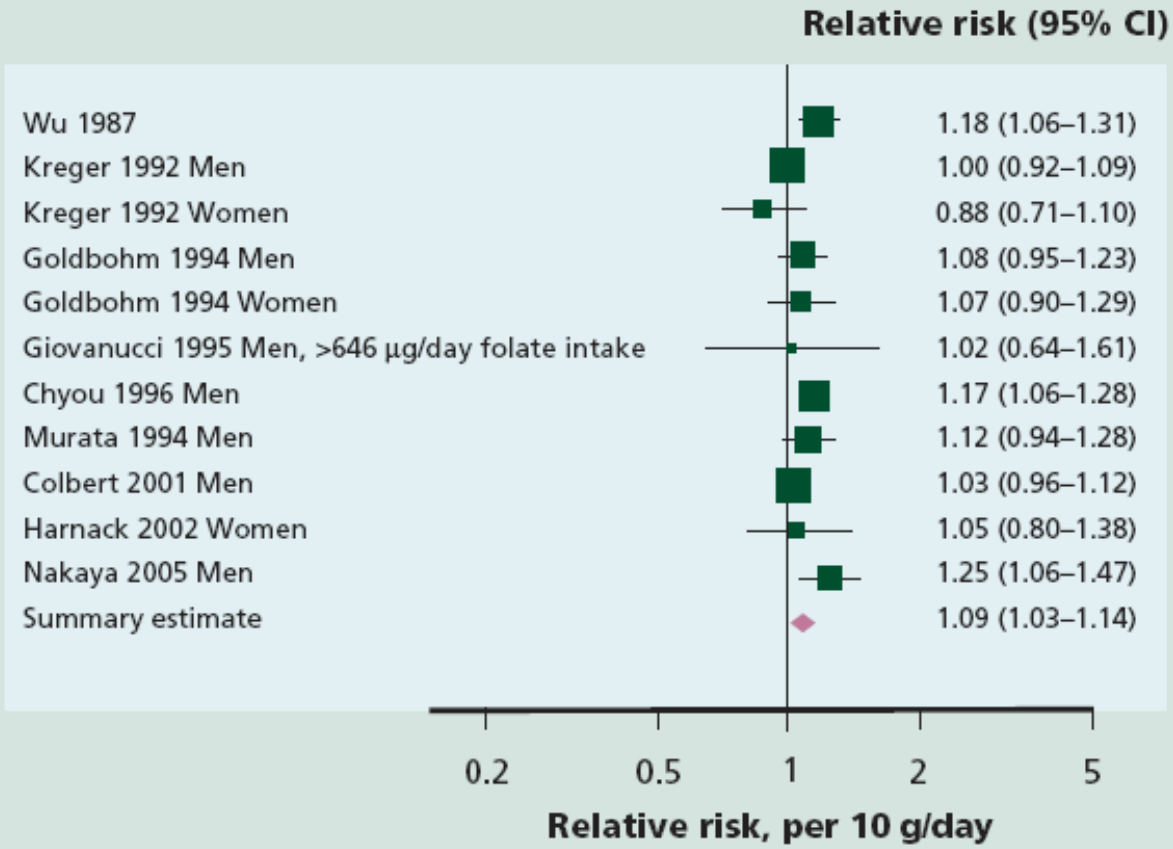


**Figure 4.8.15** Ethanol and breast cancer; cohort studies

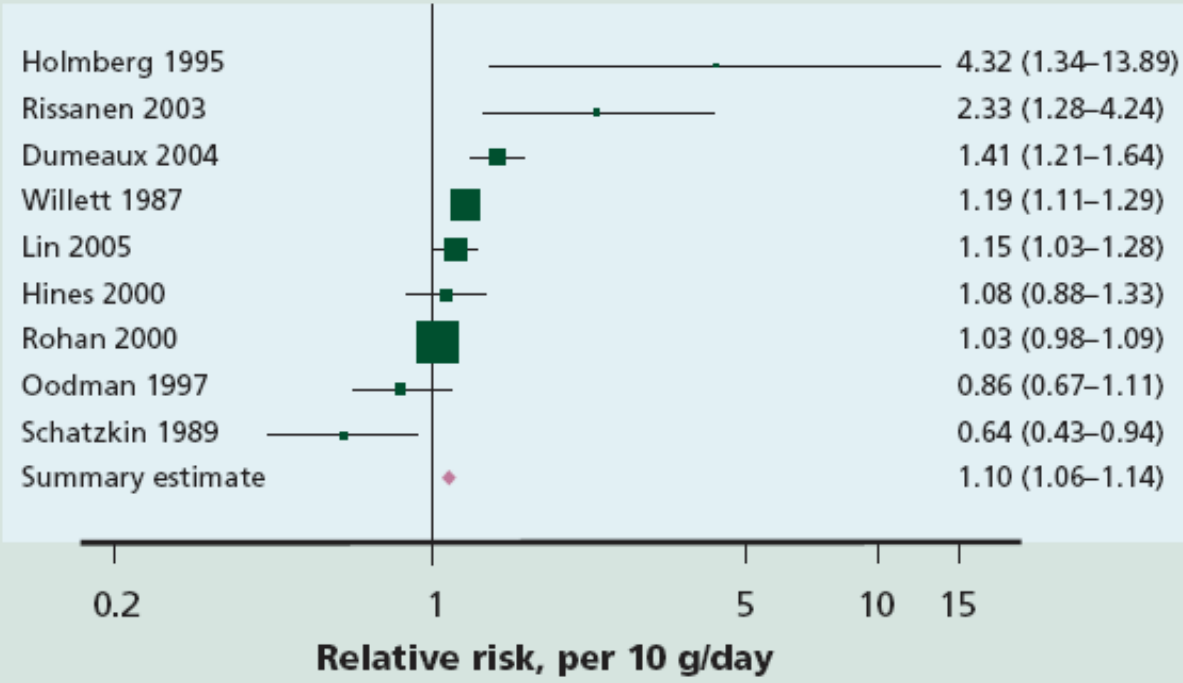
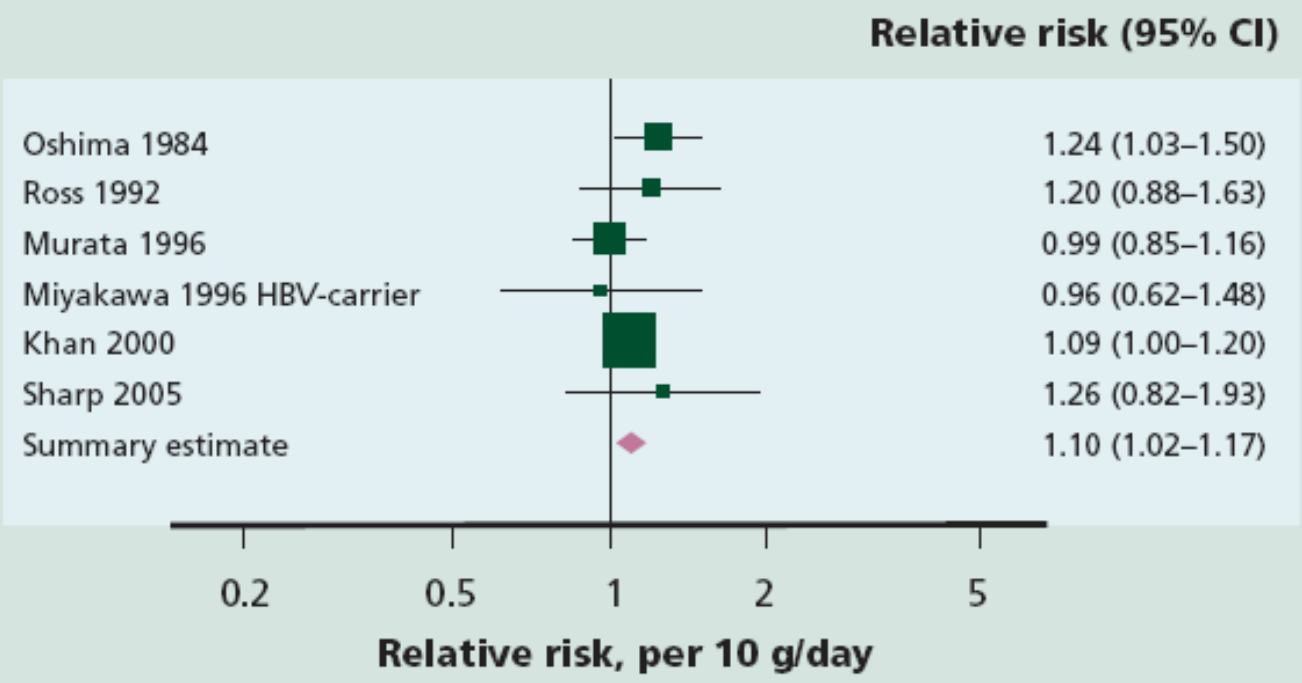


**Figure 4.8.19** **Ethanol and liver cancer; cohort studies**



RECOMMENDATION 6

## ALCOHOLIC DRINKS

**Limit alcoholic drinks[1]**

PUBLIC HEALTH GOAL

Proportion of the population drinking more than the recommended limits to be reduced by one third every 10 years[1 2]

PERSONAL RECOMMENDATION

If alcoholic drinks are consumed, limit consumption to no more than two drinks a day for men and one drink a day for women[1 2 3]

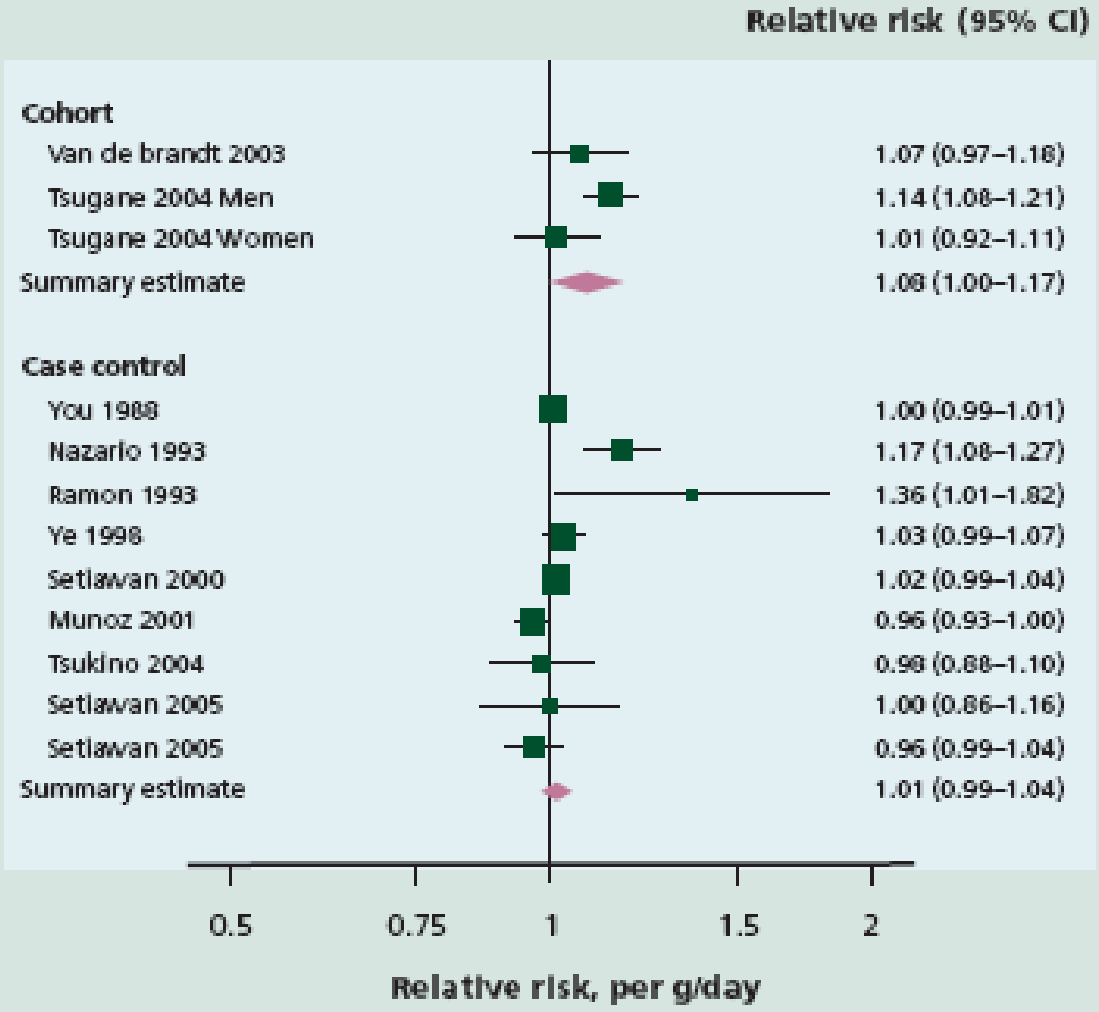
Some methods of food preservation, processing, and preparation affect the risk of cancer. The strongest evidence concerns processed meats, preserved by salting, smoking, pickling, addition of chemicals, and other methods (see recommendation 5, above); salt from all sources; and salt-preserved foods.

## SUGARS AND SALT, AND THE RISK OF CANCER

In the judgement of the Panel, the factors listed below modify the risk of cancer. Judgements are graded according to the strength of the evidence.

| | DECREASES RISK | | INCREASES RISK | |
|---|---|---|---|---|
| | Exposure | Cancer site | Exposure | Cancer site |
| **Convincing** | | | | |
| **Probable** | | | **Salt**[1]<br>**Salted and salty foods** | **Stomach**<br>**Stomach** |
| Limited — suggestive | | | Foods containing sugars[2] | Colorectum |
| **Substantial effect on risk unlikely** | None identified | | | |

**Figure 4.6.1** Total salt use and stomach cancer; cohort and case-control studies



RECOMMENDATION 7

## PRESERVATION, PROCESSING, PREPARATION

**Limit consumption of salt[1]**
**Avoid mouldy cereals (grains) or pulses (legumes)**

PUBLIC HEALTH GOALS

Population average consumption of salt from all sources to be less than 5 g (2 g of sodium) a day

Proportion of the population consuming more than 6 g of salt (2.4 g of sodium) a day to be halved every 10 years

Minimise exposure to aflatoxins from mouldy cereals (grains) or pulses (legumes)

PERSONAL RECOMMENDATIONS

Avoid salt-preserved, salted, or salty foods; preserve foods without using salt[1]

Limit consumption of processed foods with added salt to ensure an intake of less than 6 g (2.4 g sodium) a day

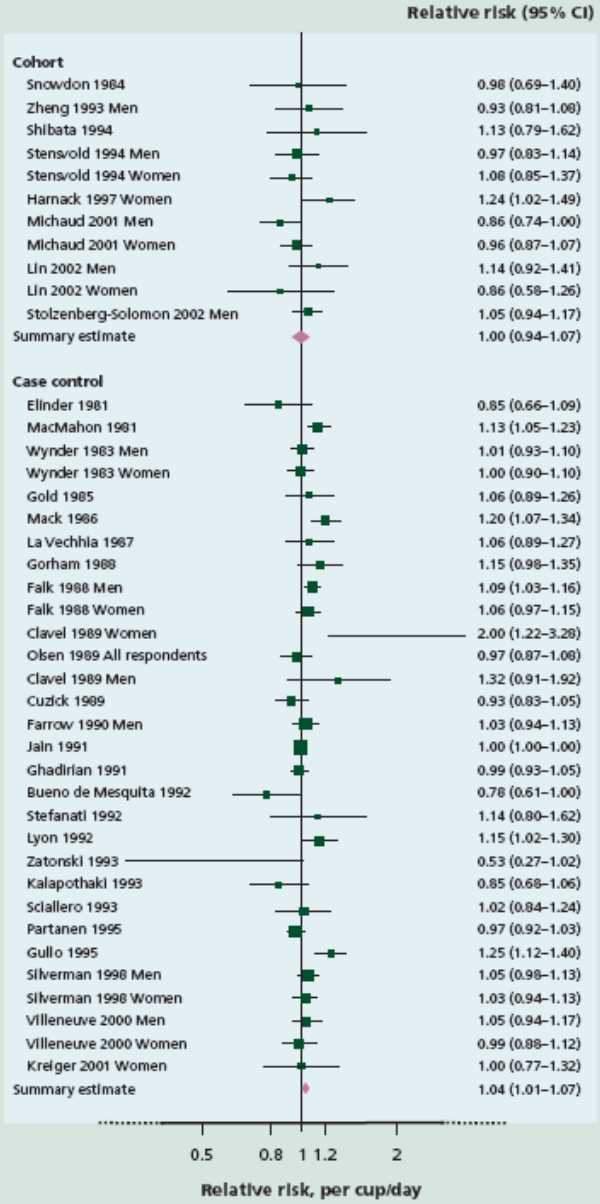
Do not eat mouldy cereals (grains) or pulses (legumes)

## WATER, FRUIT JUICES, SOFT DRINKS, HOT DRINKS, AND THE RISK OF CANCER

In the judgement of the Panel, the factors listed below modify the risk of cancer. Judgements are graded according to the strength of the evidence.

| | DECREASES RISK | | INCREASES RISK | |
|---|---|---|---|---|
| | Exposure | Cancer site | Exposure | Cancer site |
| **Convincing** | | | **Arsenic in drinking water[1]** | **Lung** |
| **Probable** | | | **Arsenic in drinking water[1]**<br>**Maté[2]** | **Skin**<br>**Oesophagus** |
| Limited — suggestive | | | Arsenic in drinking water[1]<br>Maté[2]<br>High-temperature drinks | Kidney<br>Bladder<br>Mouth, pharynx, larynx<br>Oesophagus |
| **Substantial effect on risk unlikely** | Coffee: pancreas; kidney | | | |

**Figure 4.7.1** Coffee and pancreatic cancer; cohort and case-control studies



Randomised controlled trials have produced strong evidence that high-dose supplements of some nutrients modify the risk of some cancers.

## DIETARY CONSTITUENTS AND SUPPLEMENTS, AND THE RISK OF CANCER

In the judgement of the Panel, the factors listed below modify the risk of cancer. Judgements are graded according to the strength of the evidence.

| | DECREASES RISK | | INCREASES RISK | |
|---|---|---|---|---|
| | Exposure | Cancer site | Exposure | Cancer site |
| **Convincing** | | | **Beta-carotene supplements[1]** | **Lung** |
| **Probable** | **Calcium[2]**<br>**Selenium[3]** | **Colorectum**<br>**Prostate** | | |
| Limited — suggestive | Retinol[4]<br>Alpha-tocopherol[2]<br>Selenium[3] | Skin[5]<br>Prostate<br>Lung[3]<br>Colorectum[6] | Retinol supplements[1]<br>Selenium supplements[2] | Lung<br>Skin |
| **Substantial effect on risk unlikely** | Beta-carotene[7]: prostate; skin (non-melanoma) | | | |

RECOMMENDATION 8

## DIETARY SUPPLEMENTS

**Aim to meet nutritional needs through diet alone[1]**

PUBLIC HEALTH GOAL

Maximise the proportion of the population achieving nutritional adequacy without dietary supplements

PERSONAL RECOMMENDATION

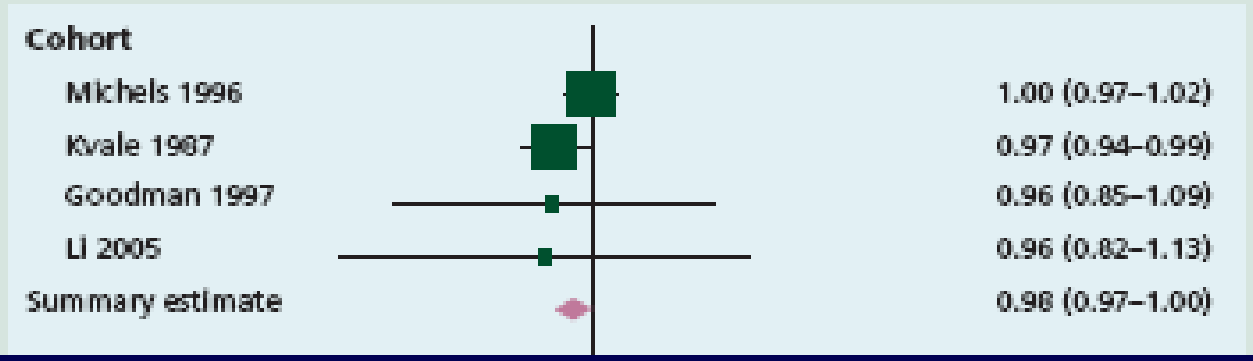
Dietary supplements are not recommended for cancer prevention

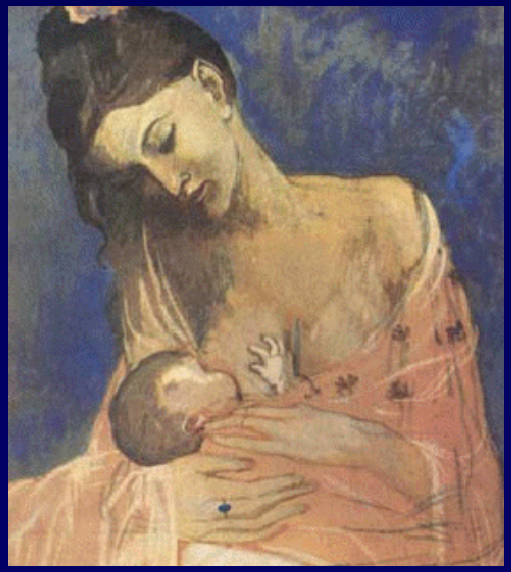
## LACTATION, AND THE RISK OF CANCER

In the judgement of the Panel, the factors listed below modify the risk of cancer. Judgements are graded according to the strength of the evidence.

| | DECREASES RISK | | INCREASES RISK | |
|---|---|---|---|---|
| | Exposure | Cancer site | Exposure | Cancer site |
| **Convincing** | **Lactation** | **Breast (pre- and postmenopause)** | | |
| **Probable** | | | | |
| Limited — suggestive | Lactation | Ovary | | |
| **Substantial effect on risk unlikely** | None identified | | | |

**Figure 6.3.1** Total duration of lactation and breast cancer (age unspecified); cohort and case-control studies



| SPECIAL RECOMMENDATION 1 |
| --- |
| **BREASTFEEDING**<br>**Mothers to breastfeed; children to be breastfed[1]** |
| PUBLIC HEALTH GOAL<br><br>The majority of mothers to breastfeed exclusively, for six months[2 3] |
| PERSONAL RECOMMENDATION<br><br>Aim to breastfeed infants exclusively[2] up to six months and continue with complementary feeding thereafter[3] |

The evidence on cancer supports the evidence on well-being, positive health, and prevention of other diseases: at the beginning of life, human milk is best.

The available evidence on cancer survivors has limitations. It is of variable quality; it is difficult to interpret; and it has not yet produced impressive results. The evidence for this review does not include the active treatment period.

SPECIAL RECOMMENDATION 2

## CANCER SURVIVORS[1]

**Follow the recommendations for cancer prevention[2]**

RECOMMENDATIONS

All cancer survivors[3] to receive nutritional care from an appropriately trained professional

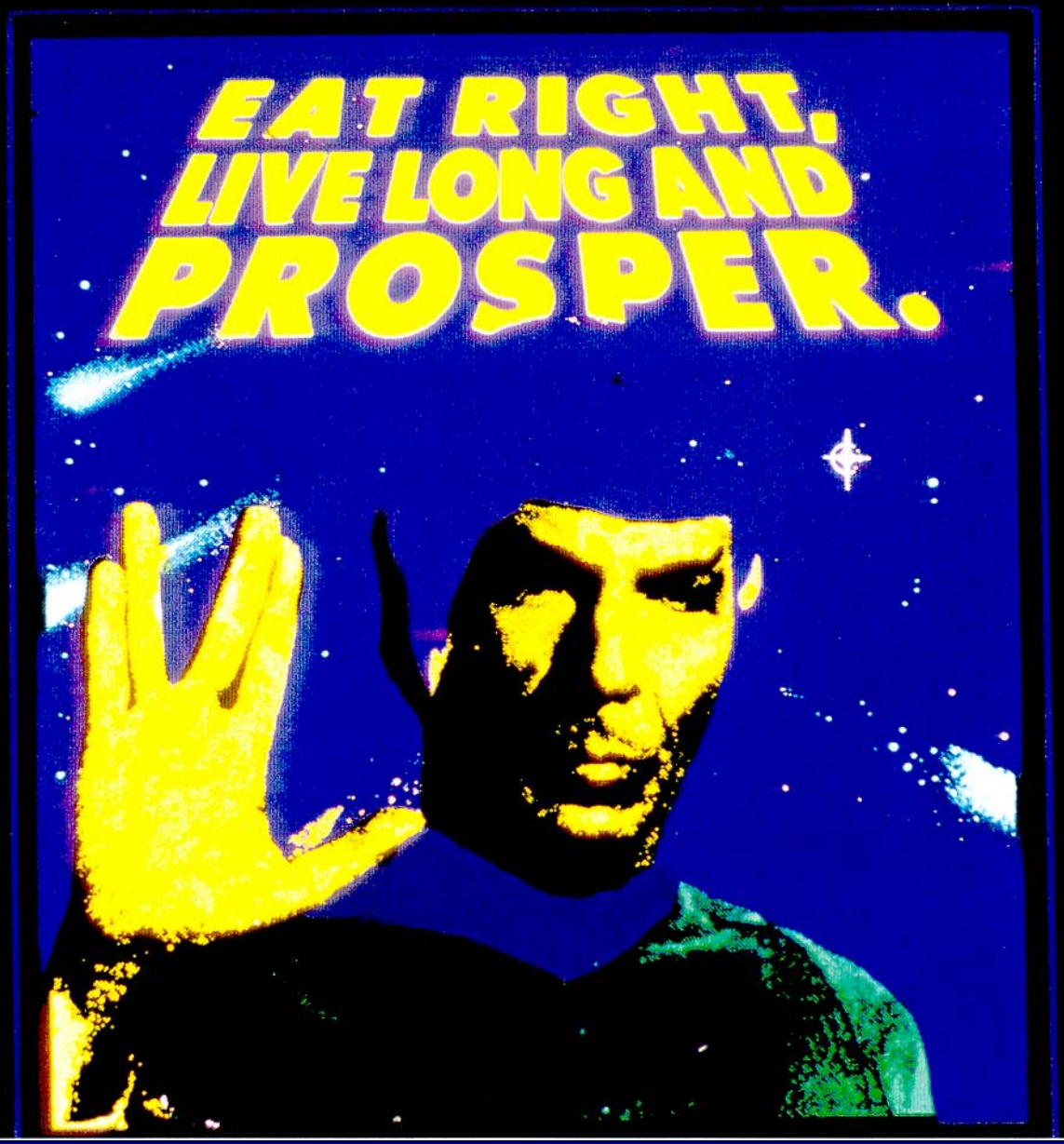
If able to do so, and unless otherwise advised, aim to follow the recommendations for diet, healthy weight, and physical activity[2]

# Recommendations and the Meaning of Life

*The Panel emphasises* that food and life should be enjoyed. *The Panel recognises* that for many people, these recommendations will involve change. People tend to enjoy ways of life that they have become used to. However, when they change, people often enjoy their new ways of life as much or more. *The Panel is aware* of the importance of aspirational goals and recommendations. To achieve substantial public and personal health gain, some of these need to be challenging.

Nutrition Recommendations

AISLE 1
GOOD FOR YOU.
AISLE 2
BAD FOR YOU.


EAT RIGHT,
LIVE LONG AND
PROSPER.

# Nutritional Epidemiology Branch

Division of Cancer Epidemiology and Genetics
National Cancer Institute