

# Bioactive food components in global public health

**Professor Martin  
Wiseman**

**University of Southampton**

**World Cancer Research Fund  
International**

# **BIOACTIVE COMPOUNDS AND CHRONIC DISEASE**

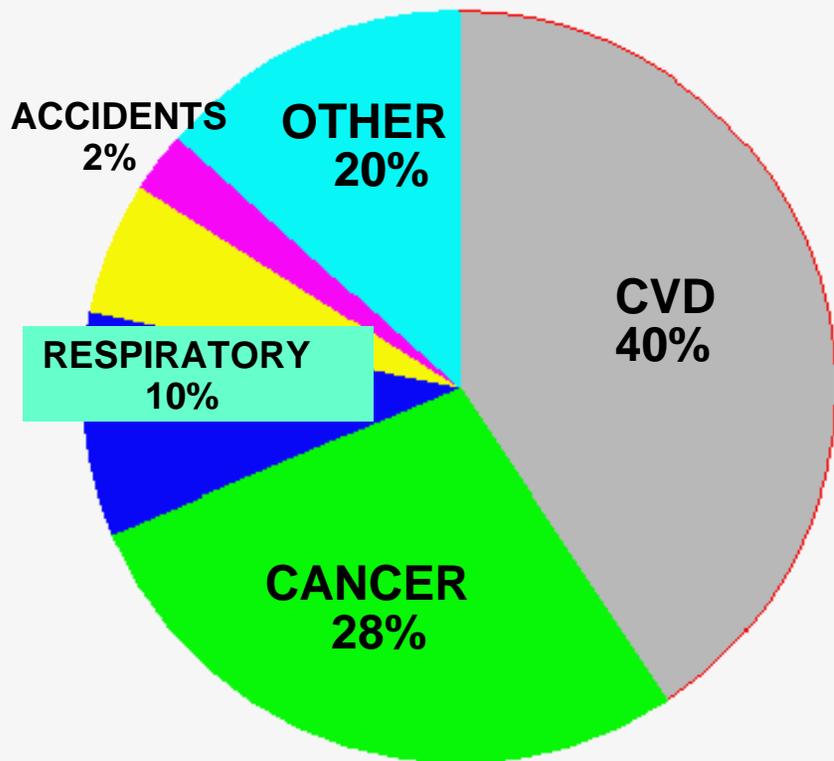
- **Burden of chronic disease**
- **Nutritional aspects**
- **Evolutionary aspects**
- **Issues and Uncertainties**
- **Proposed principles**

# **BIOACTIVE COMPOUNDS AND CHRONIC DISEASE**

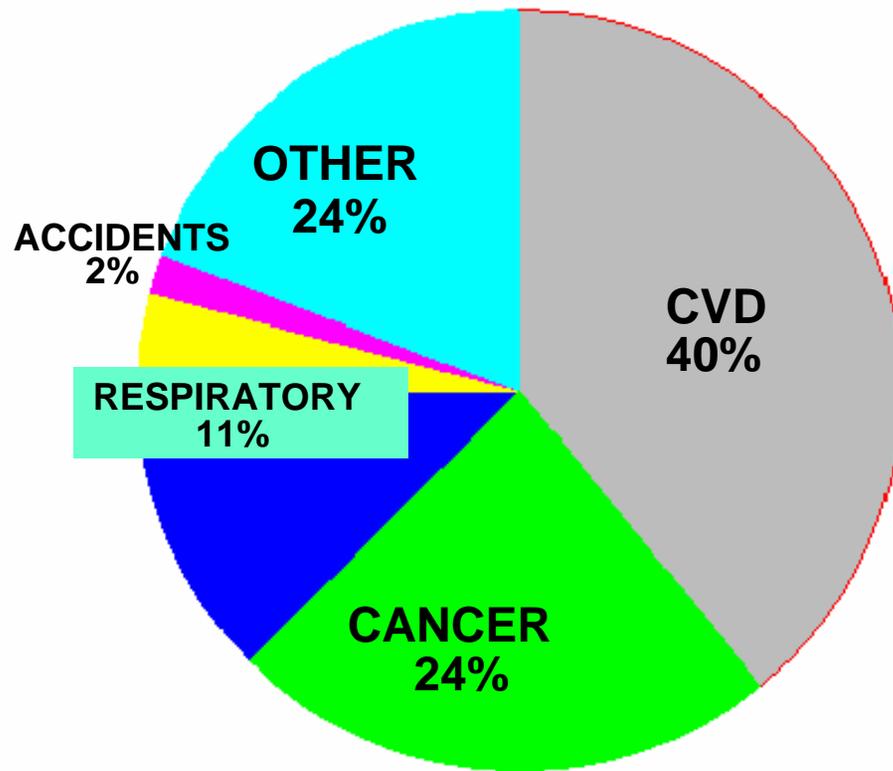
- **Burden of chronic disease**
- **Nutritional aspects**
- **Evolutionary aspects**
- **Issues and Uncertainties**
- **Proposed principles**

# CAUSE SPECIFIC MORTALITY

## ENGLAND 2000



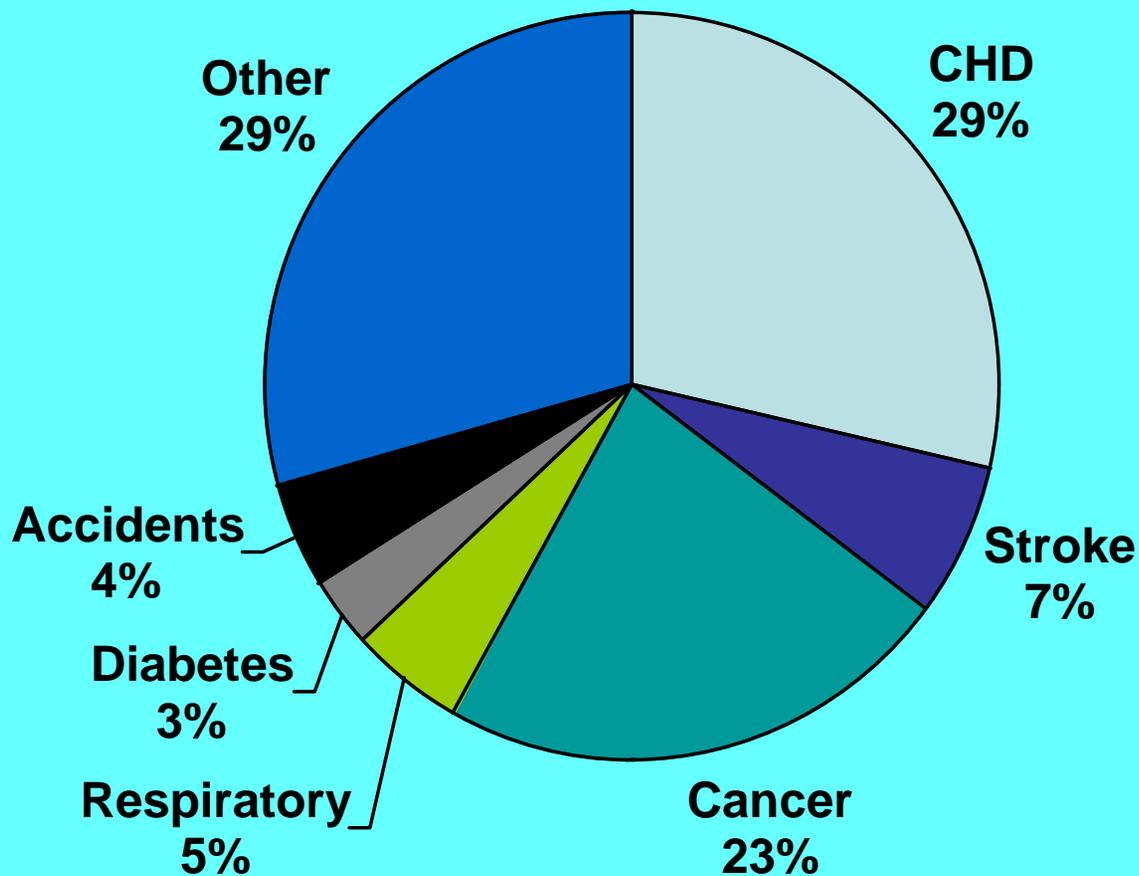
**MALE**



**FEMALE**

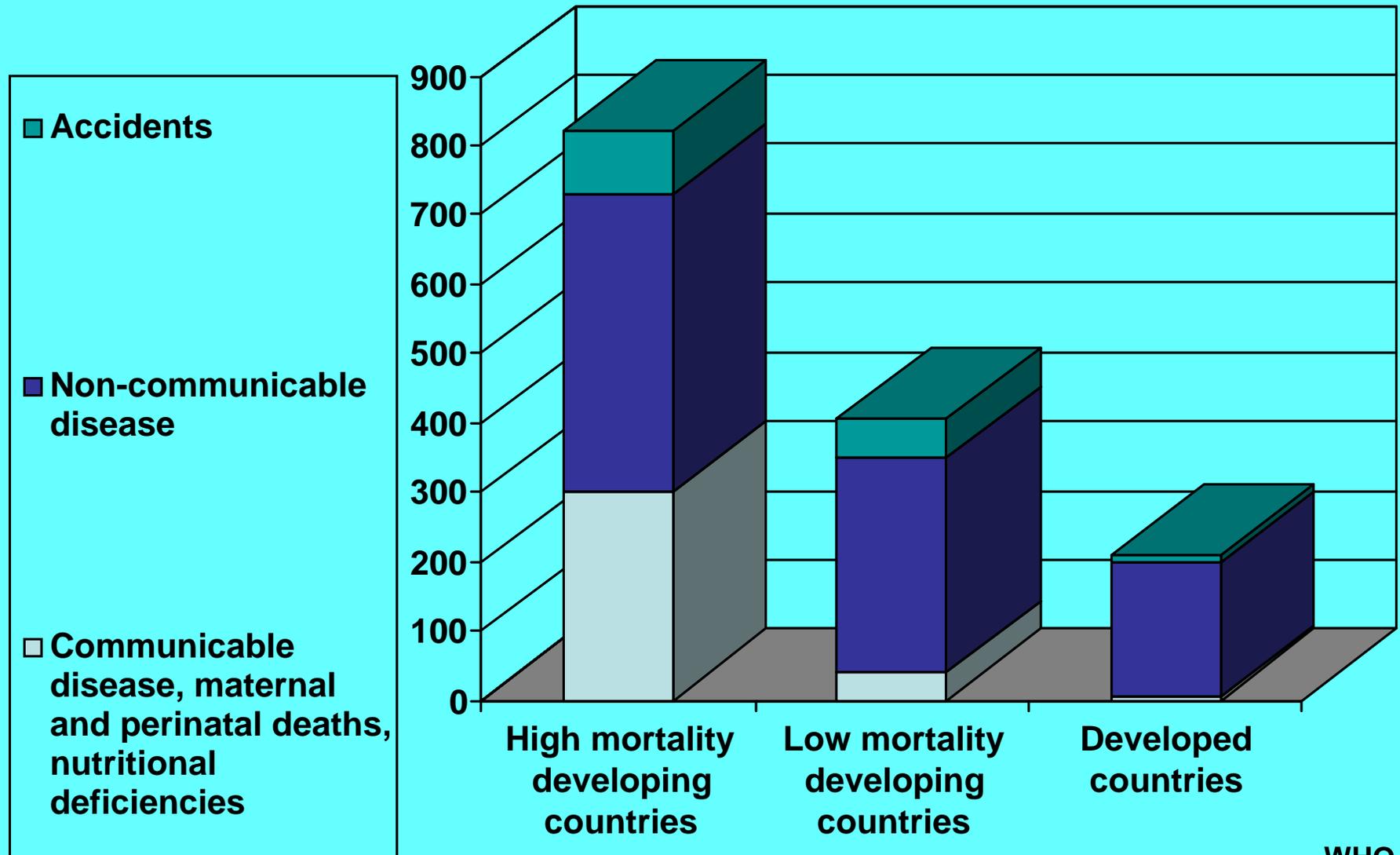
- All circulatory diseases
- All Malignant Neoplasms
- Pneumonia
- Bronchitis and allied conditions
- All accidents & adverse effects
- Other

# MAJOR CAUSES OF DEATH USA 2002



NCHS 2005

# GLOBAL DISTRIBUTION OF CAUSES OF DEATHS



# BIOACTIVE COMPOUNDS AND CHRONIC DISEASE

- Burden of chronic disease
- **Nutritional aspects**
- Evolutionary aspects
- Issues and Uncertainties
- Proposed principles

# **Nutrition and chronic disease**

- **Cardiovascular diseases**
- **Cancer**
- **Bone health**
- **Obesity**
- **Diabetes**

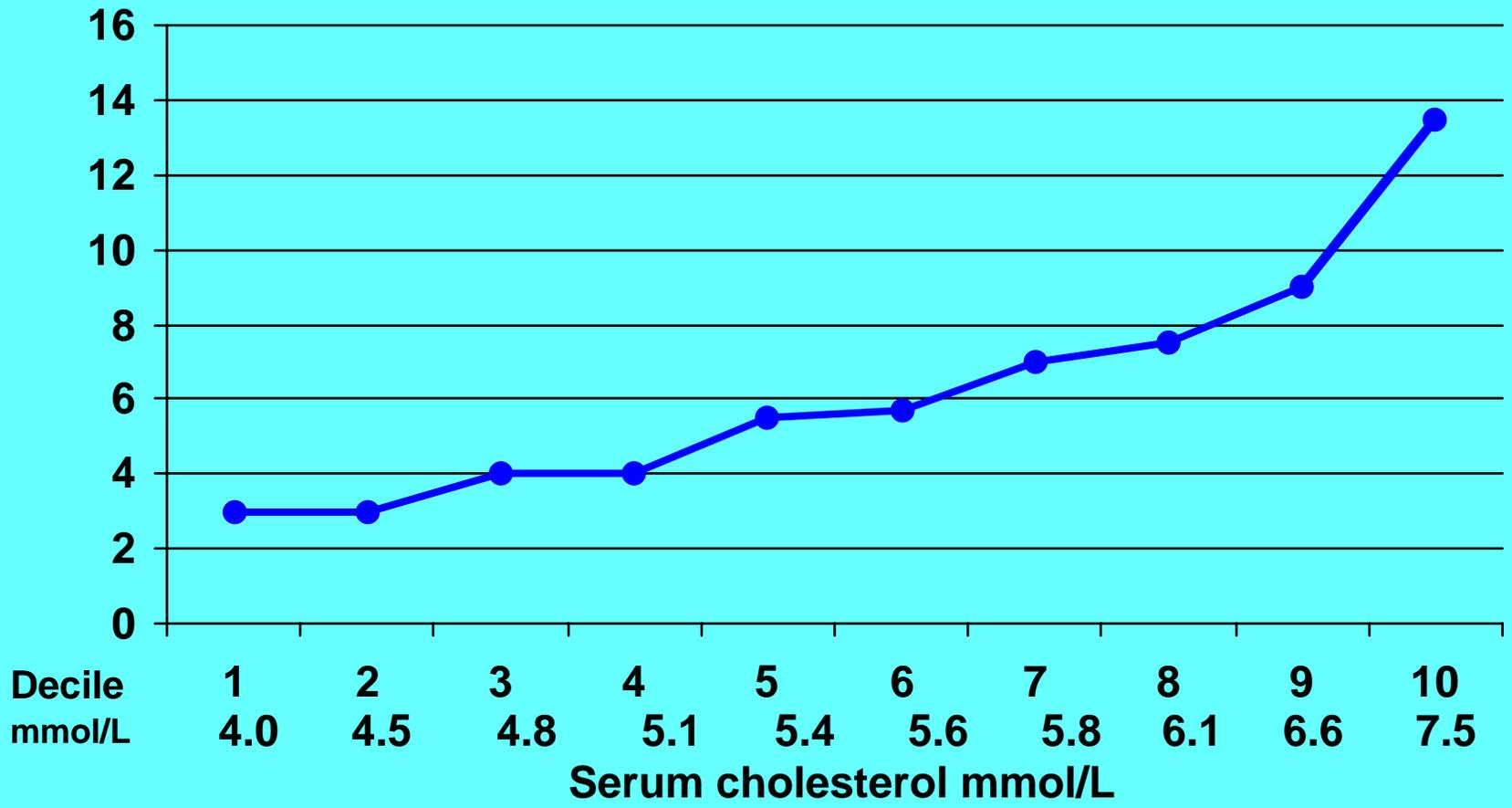
# **Nutrition and chronic disease**

- **Cardiovascular diseases**
- **Cancer**
- **Bone health**
- **Obesity**
- **Diabetes**

# CHD Mortality and Serum Cholesterol

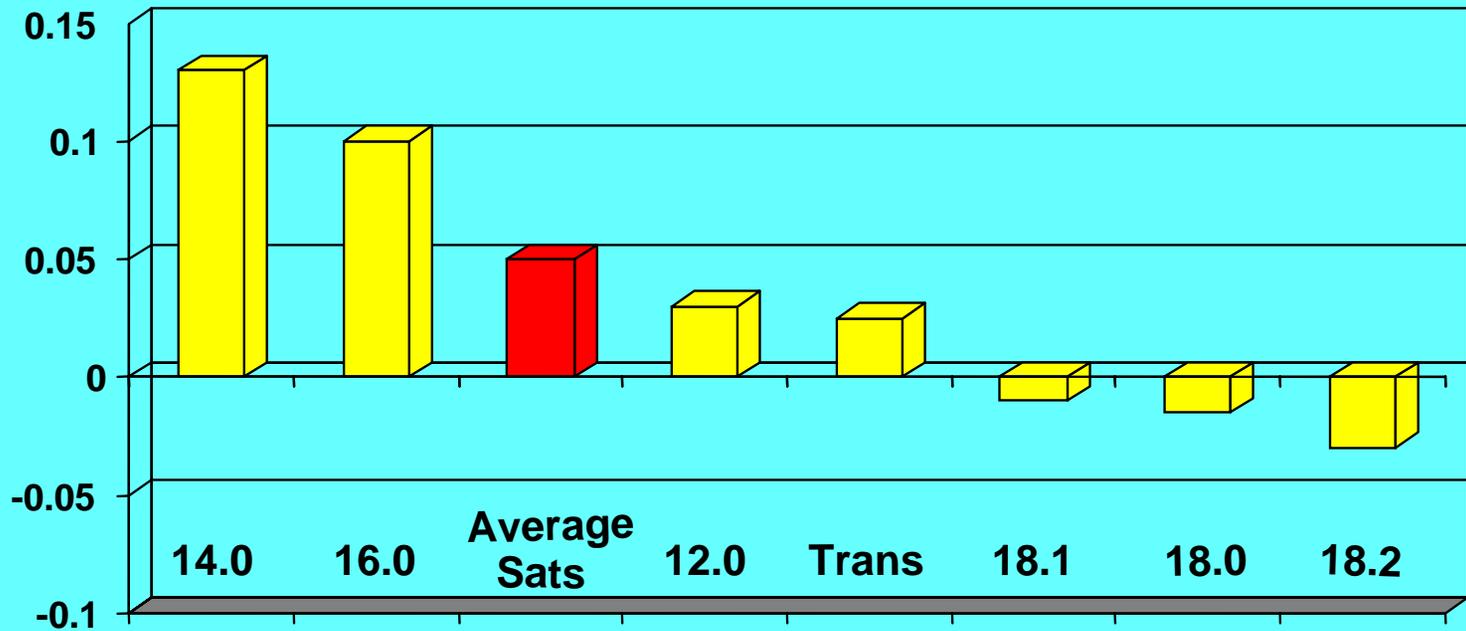
MRFIT n=356222

Deaths per 1000



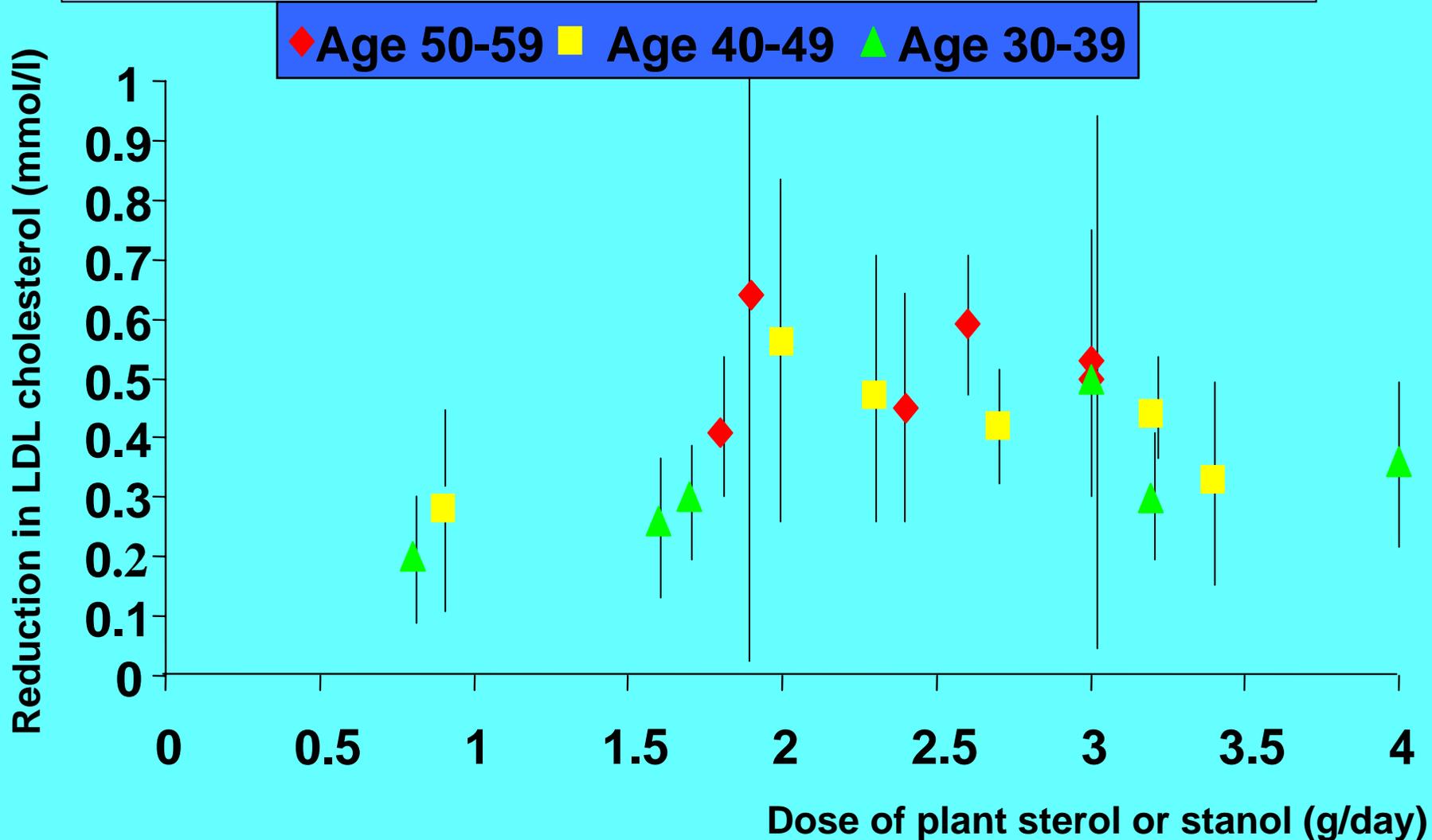
# Dietary Fatty Acids and Total Serum Cholesterol

Change in total serum cholesterol (mmol/L)  
per 1% energy change in kcal from fat

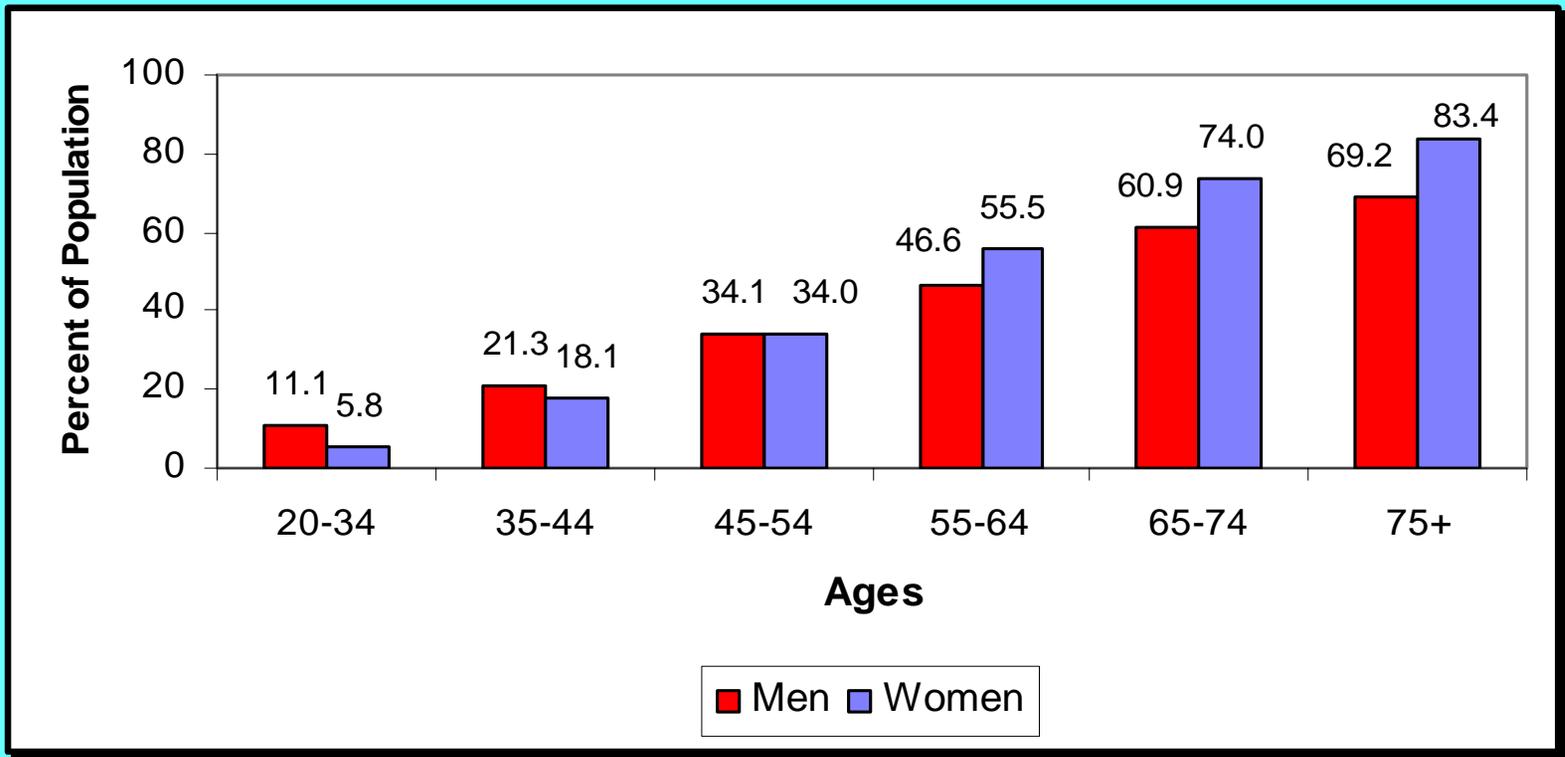


Modified from Grundy et al 1981

# CHANGE IN LDL-CHOLESTEROL WITH PLANT STEROLS OR STANOLS

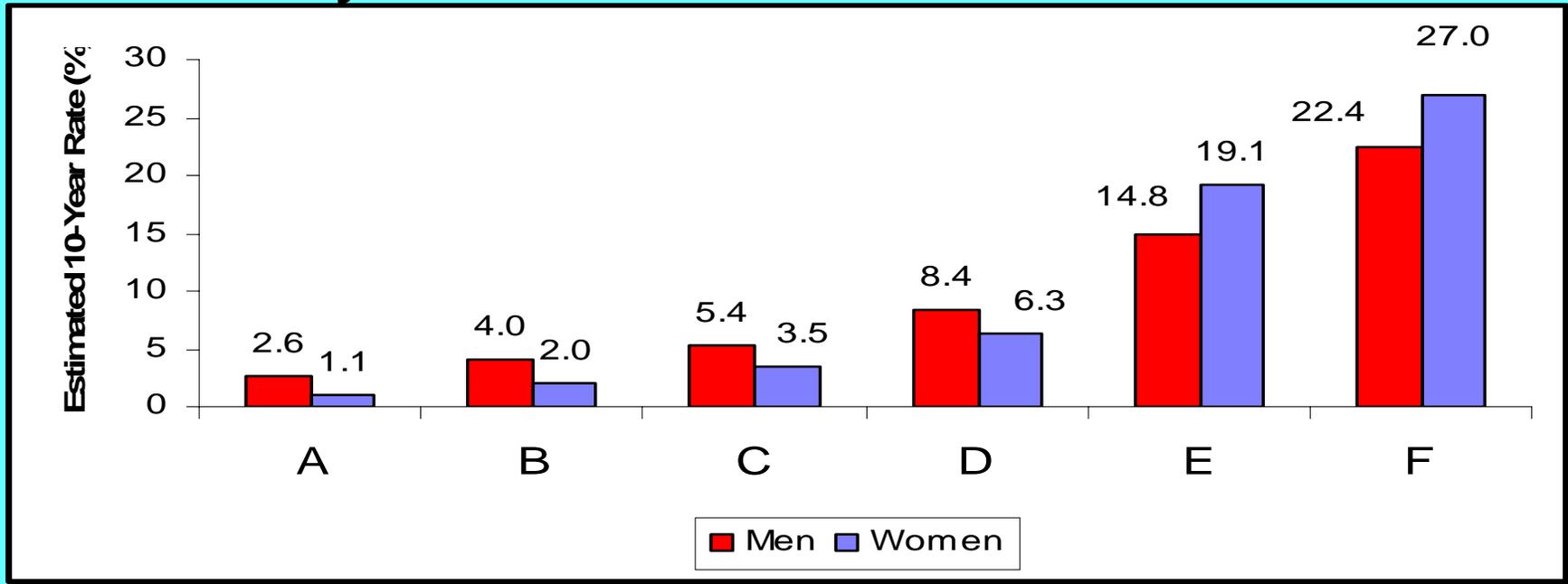


# Prevalence of High Blood Pressure in Americans by Age and Sex NHANES: 1999-2002



*Source: CDC/NCHS and NHLBI.*

# Estimated 10-Year Stroke Risk in 55-Year-Old Adults According to Levels of Various Risk Factors - Framingham Heart Study

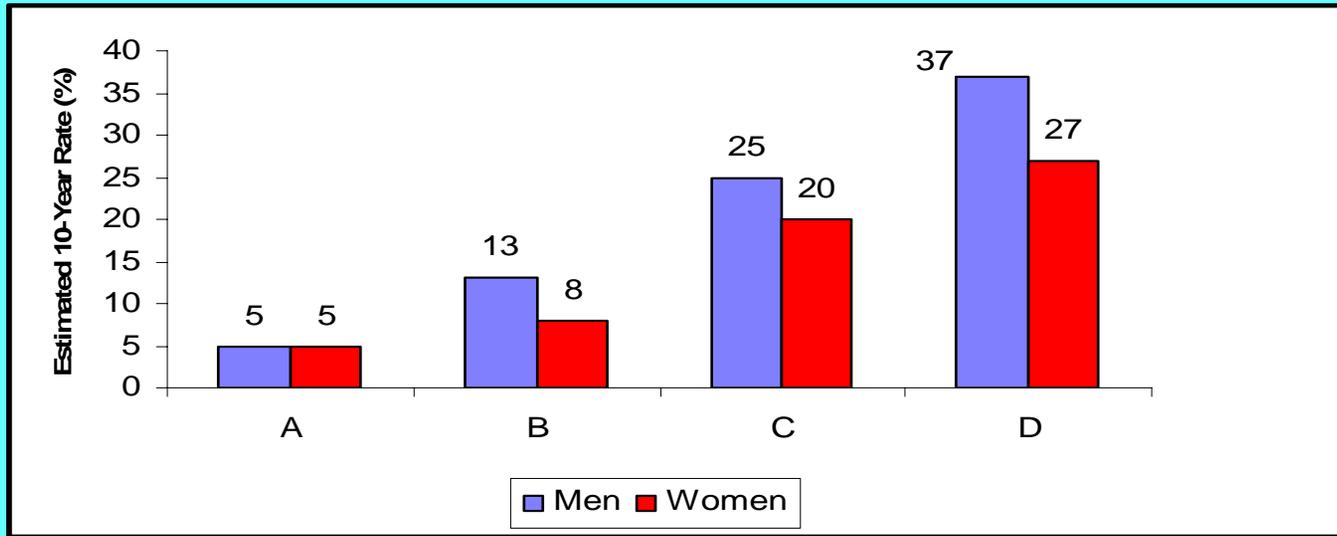


	A	B	C	D	E	F
Systolic BP	95-105	130-148	130-148	130-148	130-148	130-148
Diabetes	No	No	Yes	Yes	Yes	Yes
Cigarettes	No	No	No	Yes	Yes	Yes
Prior Atrial Fib.	No	No	No	No	Yes	Yes
Prior CVD	No	No	No	No	No	Yes

*Source: Stroke 1991;22:312-318.*

# Estimated 10-Year CHD Risk in 55-Year-Old Adults According to Levels of Various Risk Factors

Framingham Heart Study

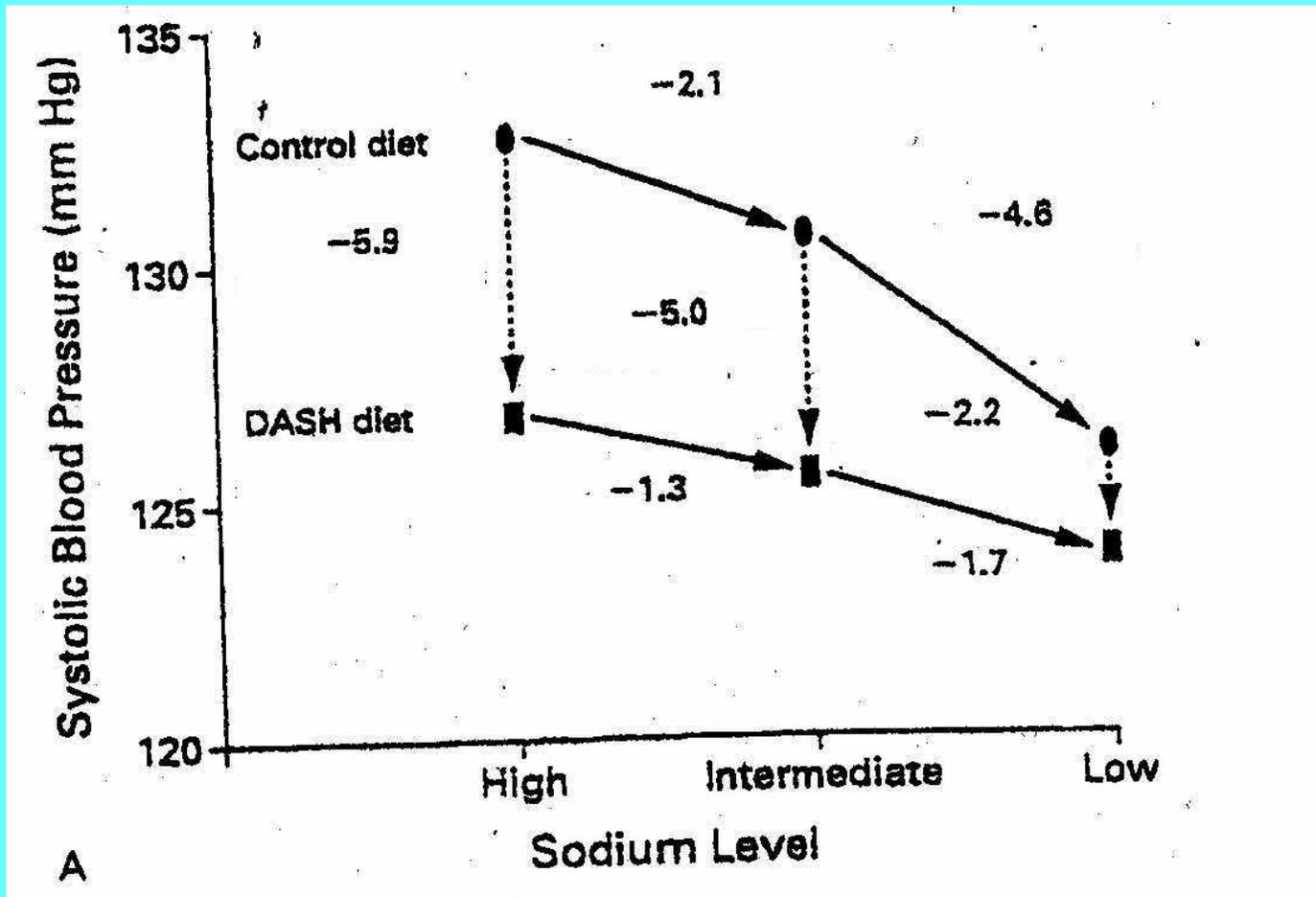


	A	B	C	D
Blood Pressure (mm Hg)	120/80	140/90	140/90	140/90
Total Cholesterol (mg/dL)	200	240	240	240
HDL Cholesterol (mg/dL)	50	50	40	40
Diabetes	No	No	Yes	Yes
Cigarettes	No	No	No	Yes

**I** mm Hg = millimeters of mercury  
 mg/dL = milligrams per deciliter of blood

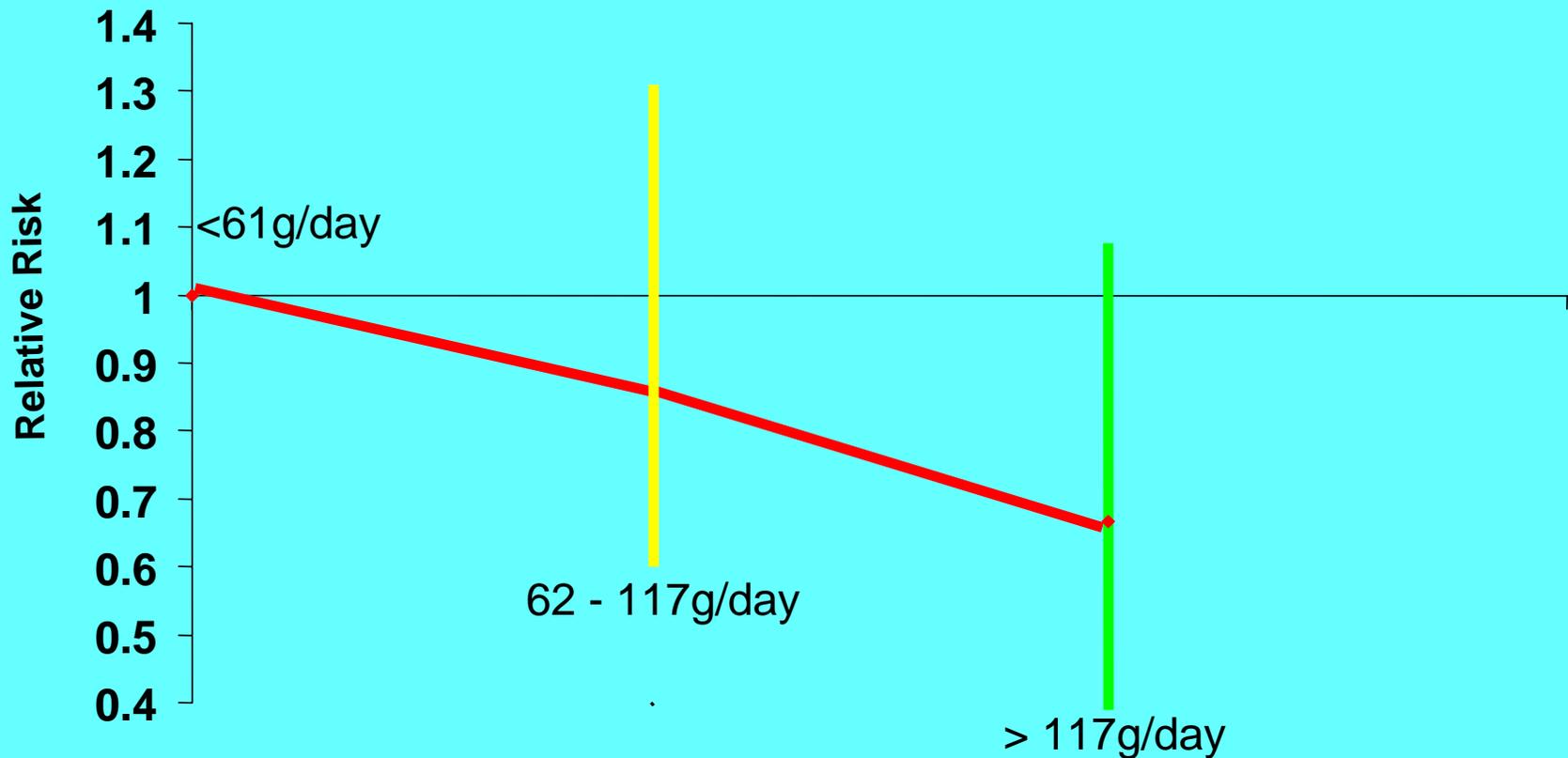
**Source:** *Wilson PWF, et al. Circulation 1998;97:1837-1847.*

# The Dietary Approaches to Stop Hypertension (DASH) trial



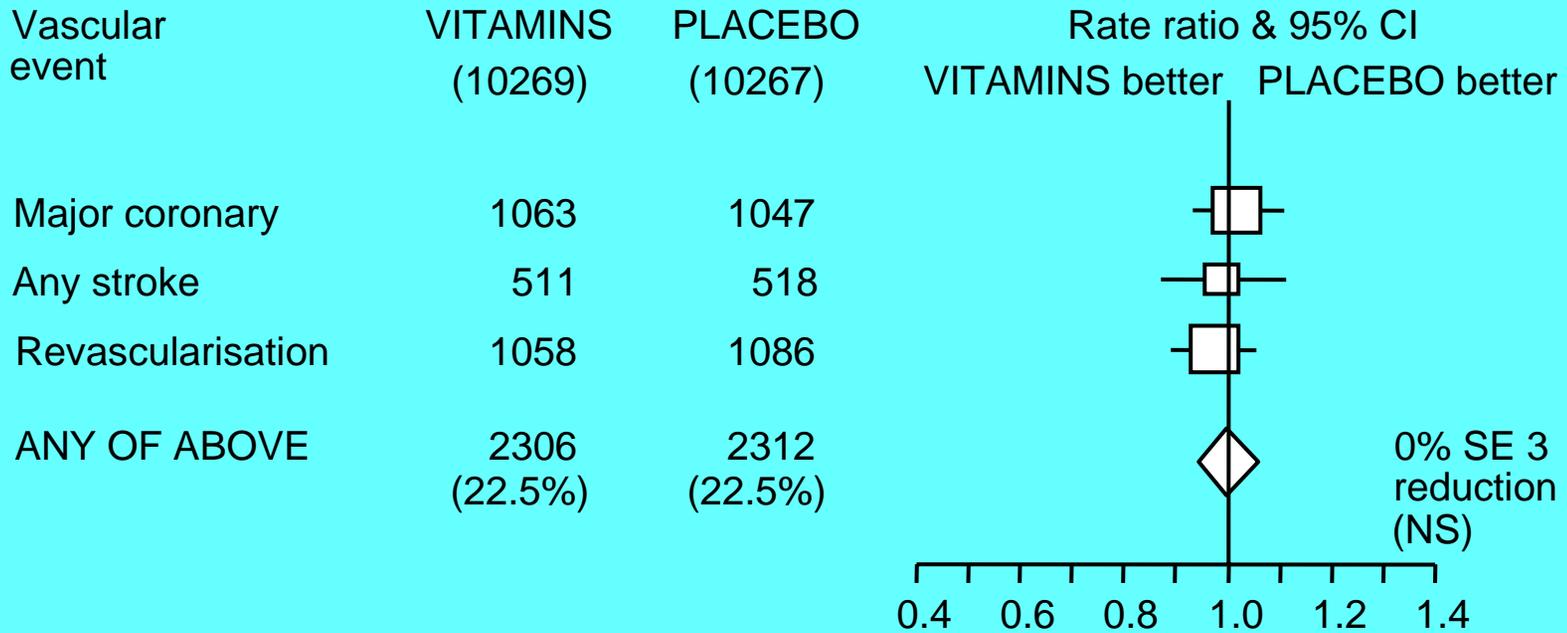
Sacks et al, 2001

# Vegetable intake and Relative Risk of CHD Mortality in Men



Adjusted for age and energy, carotenoids, vitamins E and C intakes

# VITAMINS: MAJOR VASCULAR EVENTS



Vitamins = 600 mg E, 250 mg C and 20 mg beta-carotene

Heart Protection Study 2002

# Homocysteine and CHD Observational Studies

Degree of  
adjustment

++++  
++++  
+++  
+++  
+++

+++  
+++  
+++  
+++  
++  
+  
-  
-  
-  
-

-  
-  
-  
-  
-  
-

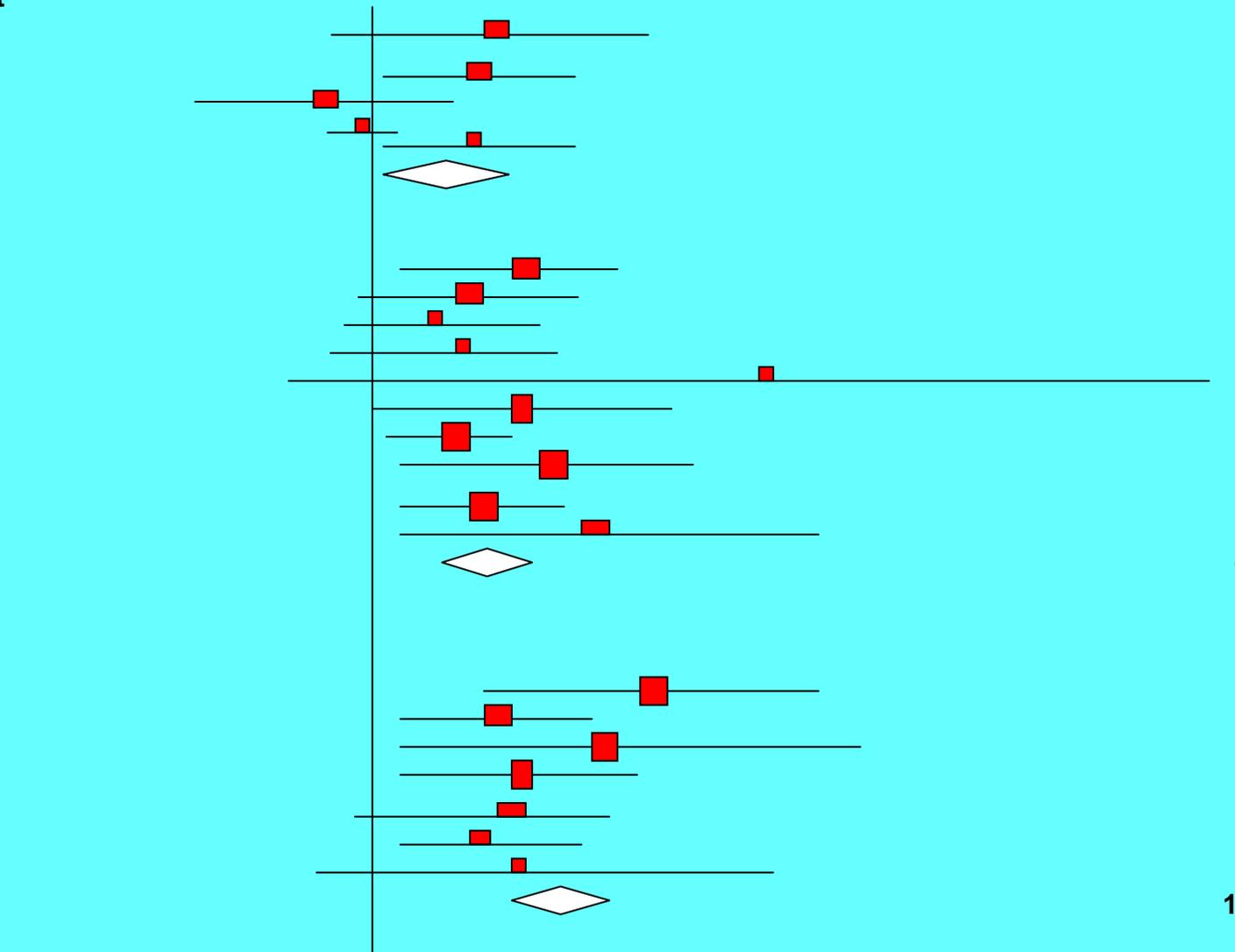
1.3 (1.1-1.5)

1.6 (1.4-1.7)

1.9 (1.6-2.3)

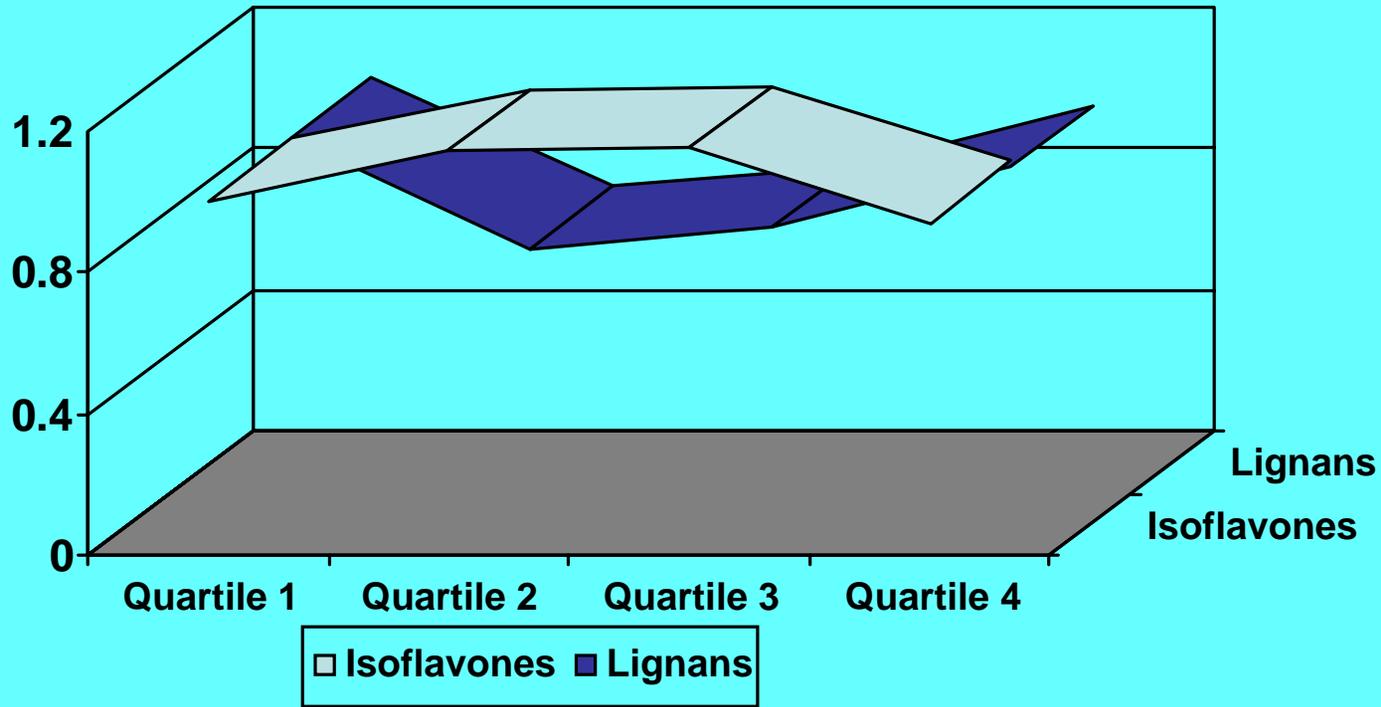
Relative Risk

0.5      1      2      4      6      8

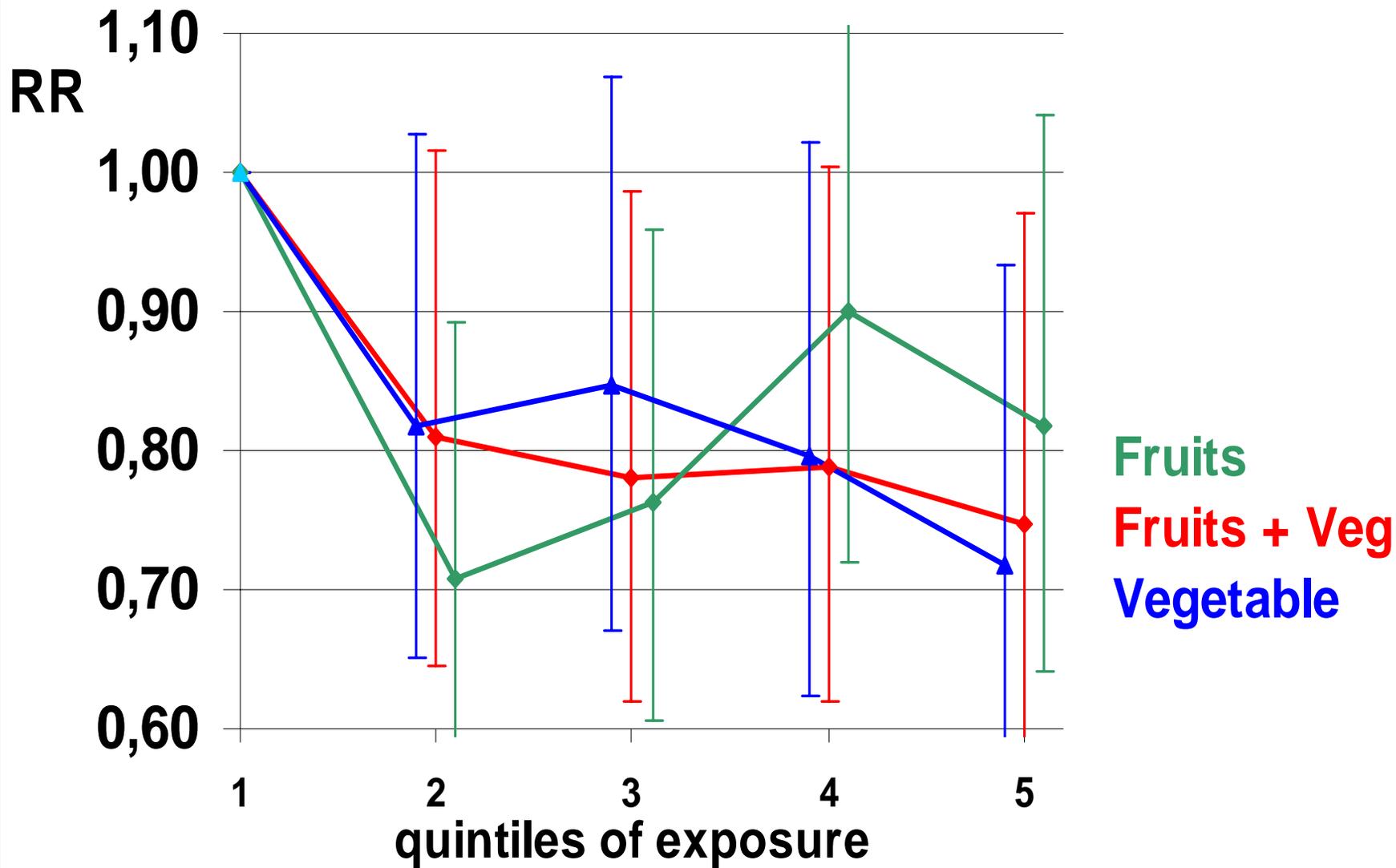


# PHYTOESTROGENS AND CARDIOVASCULAR DISEASE

Hazard ratio

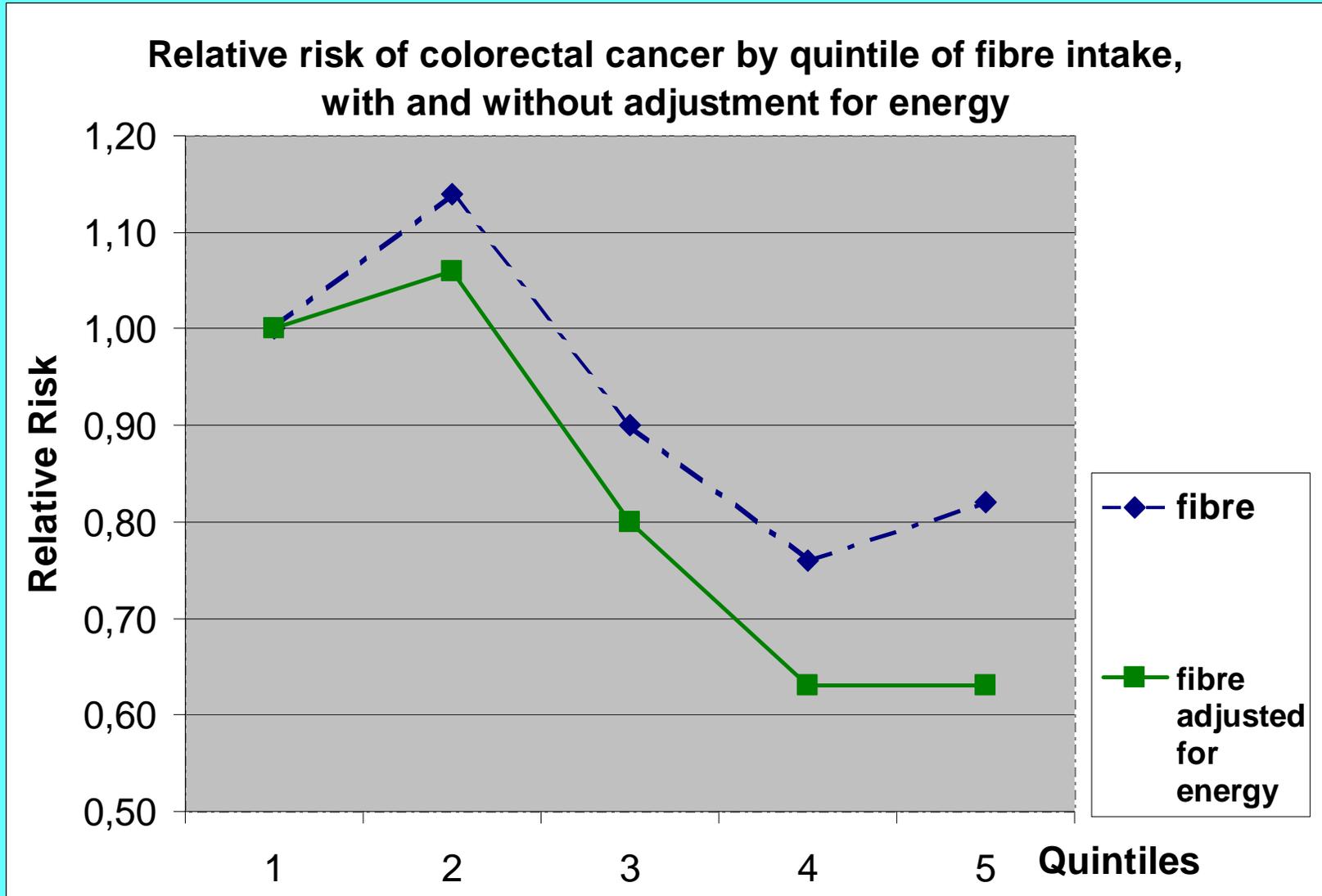


# EPIC: Colorectal cancer risk

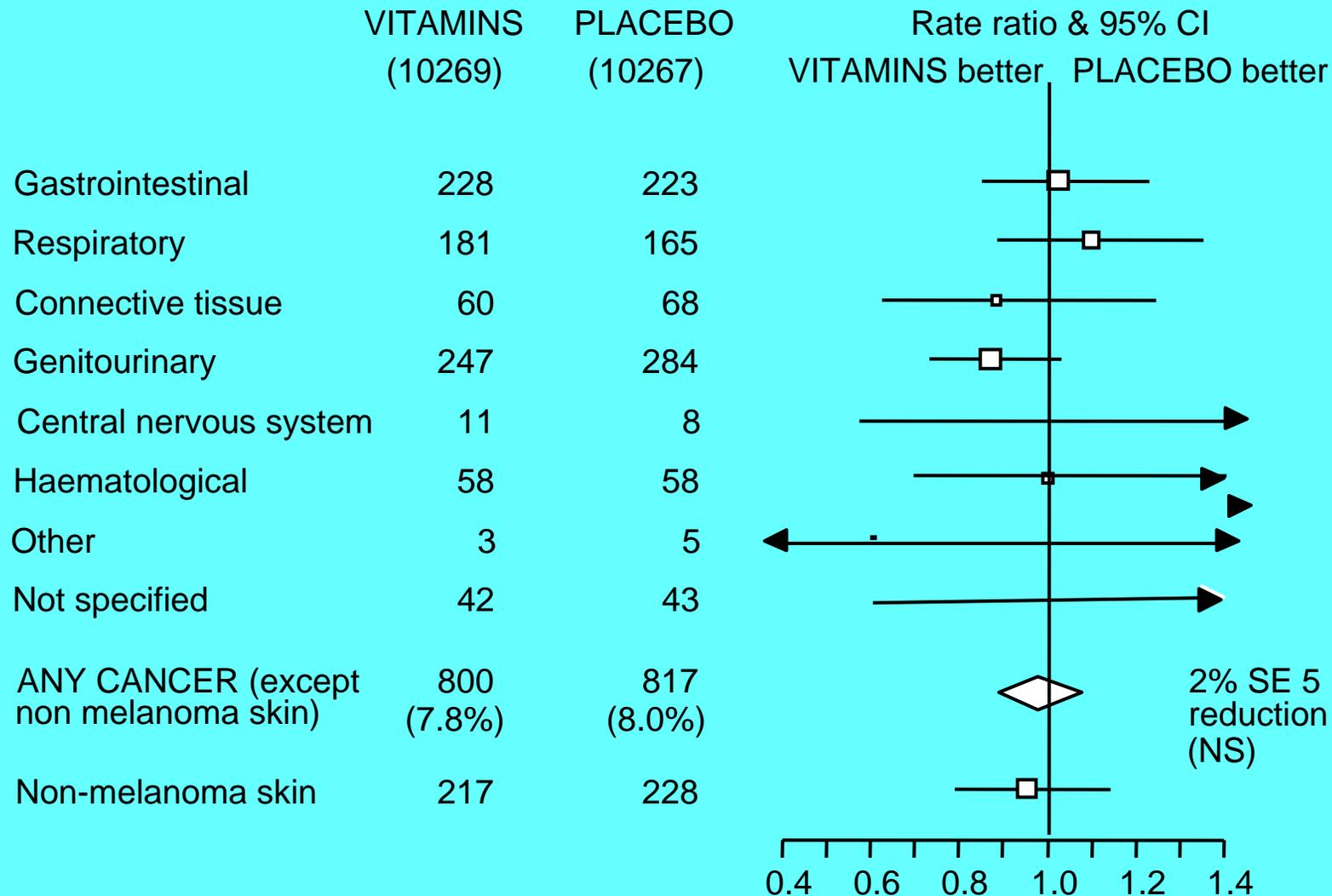


Statistical models adjusted by height, weight, physical activity, energy intake, smoking

# EPIC



# VITAMINS: SITE-SPECIFIC CANCER INCIDENCE



Heart Protection Study, 2002

# **Chronic disease - nutritional perspective**

- Human nutrition - Demand-led process; supply to meet physiological demand for function (metabolism, mechanical work)
- Demand depends on genetic background, lifetime experience, and current environment
- Human metabolism evolved through natural selection
- Natural selection operates through reproductive inheritance

# Chronic disease - nutritional perspective

- Nutrient - component of metabolic pathways (or precursor) found in food/drink
- Essential nutrients - essential components of metabolism expected in the environment - biosynthetic pathways not preserved
- “Non-essential” nutrients - essential components of metabolism whose biosynthetic pathways must be preserved

# **Bioactive compounds - nutritional perspective**

- Are they nutrients?
- Are they essential?
- Is there a physiological demand?

# **Bioactive compounds - nutritional perspective**

- Are they nutrients? NO
- Are they essential?
- Is there a physiological demand?

# **Bioactive compounds - nutritional perspective**

- Are they nutrients? NO
- Are they essential? NO
- Is there a physiological demand?

# **Bioactive compounds - nutritional perspective**

- Are they nutrients? NO
- Are they essential? NO
- Is there a physiological demand? NO

# **Bioactive compounds - nutritional perspective**

- Are they nutrients? NO
- Are they essential? NO
- Is there a physiological demand? NO
- So does their supply influence metabolism and health and if so how?

# BIOACTIVE COMPOUNDS AND CHRONIC DISEASE

- Burden of chronic disease
- Nutritional aspects
- **Evolutionary aspects**
- Issues and Uncertainties
- Proposed principles

QuickTime™ and a  
Uncompressed) decompressor  
needed to see this picture.

QuickTime™ and a  
TIFF (Uncompressed) decompressor  
are needed to see this picture.

QuickTime™ and a  
TIFF (Uncompressed) decompressor  
are needed to see this picture.

QuickTime™ and a  
TIFF (Uncompressed) decompr  
are needed to see this picture

QuickTime™ and a  
Uncompressed) decompressor  
needed to see this picture.

QuickTime™ and a  
TIFF (Uncompressed) decompressor  
are needed to see this picture.

QuickTime™ and a  
TIFF (Uncompressed) decompressor  
are needed to see this picture.

# CANCER INCIDENCE WITH AGE

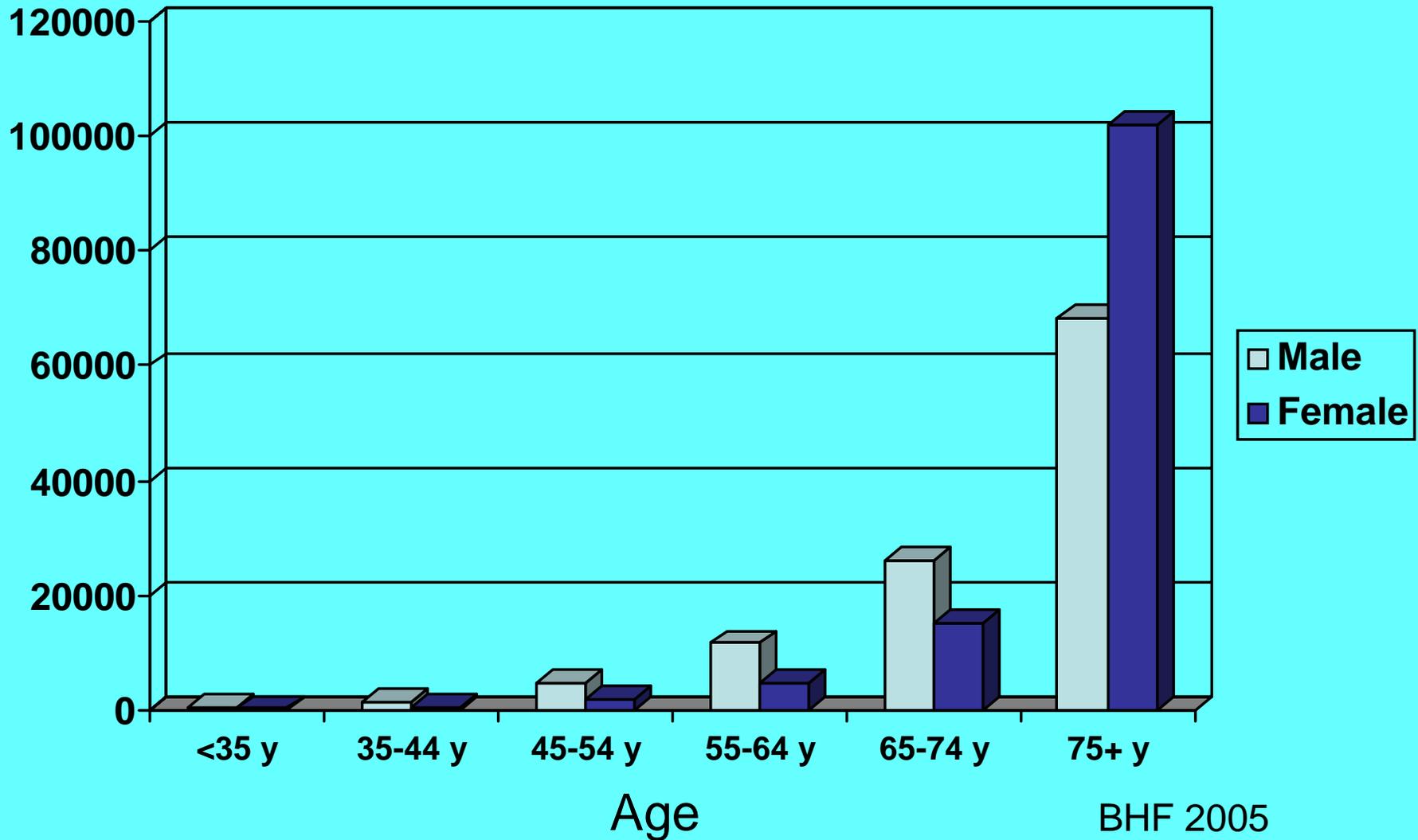
## UK 2001

QuickTime™ and a  
TIFF (Uncompressed) decompressor  
are needed to see this picture.

# CVD DEATHS BY AGE

UK 2001

Deaths



# **Bioactive compounds - evolutionary perspective**

- Post-reproductive events largely irrelevant to natural selection
- Post-reproductive effects of environmental exposures cannot be predicted on evolutionary basis
- Bioactive compounds do not meet evolutionarily determined metabolic demand

# BIOACTIVE COMPOUNDS AND CHRONIC DISEASE

- Burden of chronic disease
- Nutritional aspects
- Evolutionary aspects
- **Issues and Uncertainties**
- Proposed principles

# Bioactive food components

- Amount and form consumed
- Absorption - effects if not absorbed
- Metabolism
- Systemic, tissue, intracellular distribution
- Effects of metabolites
  - Biochemistry of etiologic pathway
  - Validated markers of risk?
  - Effects in vitro, in animal model
  - Effects in human in vivo
- Interactions
- Biological effects vs health effects

# Foods and chronic disease

- Food components vs whole diets
  - Interactions
  - Confounding
    - Food, diet, behaviour
  - Dose
  - Formulation
  - Study design

# Foods and chronic disease

- Evidence issues
  - Simple vs complex models and interventions
  - Timing of intervention
  - Duration of intervention
- Type of evidence
  - Trial vs observational
  - Prospective vs retrospective
  - Laboratory vs clinical
- Complexity of foods/diets/lifestyle
  - Confounding - cause/effect
  - Interactions

# **BIOACTIVE COMPOUNDS AND CHRONIC DISEASE**

- **Burden of chronic disease**
- **Nutritional aspects**
- **Evolutionary aspects**
- **Issues and Uncertainties**
- **Proposed principles**

# BIOACTIVE COMPOUNDS AND CHRONIC DISEASE

- Foods and diets associate with chronic disease risk
- Foods and diets are complex and associate with other behaviors
- Many food components have biological activity
- Some bioactive components may have health promoting potential
- Some bioactive components may have adverse effects

# **BIOACTIVE COMPOUNDS AND CHRONIC DISEASE**

- Does this potential translate to reality?
- How to test this?
- What paradigm to use?

# Bioactive food components

- Epidemiology - associations
- Physiology - absorption, metabolism, distribution and utilisation
- Lab - potential efficacy/safety
- “Omics” - human biology
- Clinical - human health
  - Dose/form
  - Population studied
  - Timing of intervention
  - Duration of intervention
  - Outcomes
    - intermediate or health
    - beneficial or adverse

# BIOACTIVE COMPOUNDS AND CHRONIC DISEASE

- Bioactive food components are incidental to nutrition
- Food components can have adverse and positive effects
- Studies need to address effectiveness in prevention and treatment - hard end points
- Better elucidation of the etiologic pathway and the effects of bioactive components is key to designing informative clinical studies
- Effects on validated determinants of risk need to be demonstrated
- Research on food components is important

# BIOACTIVE COMPOUNDS AND CHRONIC DISEASE

- For global public health population-wide interventions are needed
- Interventions must have demonstrated high benefit to risk ratio
- Varying exposures beyond usual experience needs to demonstrate both safety and efficacy
- Unusual interventions (single component, non-nutrient, high dose) are not meeting nutritional demand and a pharmacologic paradigm is appropriate at present
- Current public health strategies should be food based