Epidemiology of Cancer

9/1/16

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With thanks to Dr Kirsten Moysich for some slides

Epidemiology

- the branch of medicine that deals with the incidence, distribution, determinants and control of diseases and other factors relating to health

- Epidemiology is the study of the **frequency** and **pattern** of health events in a population

Outline

- Cancer Incidence
- Cancer Mortality
- Geographic Variation
- Racial Variation
- Risk Factors
- Screening

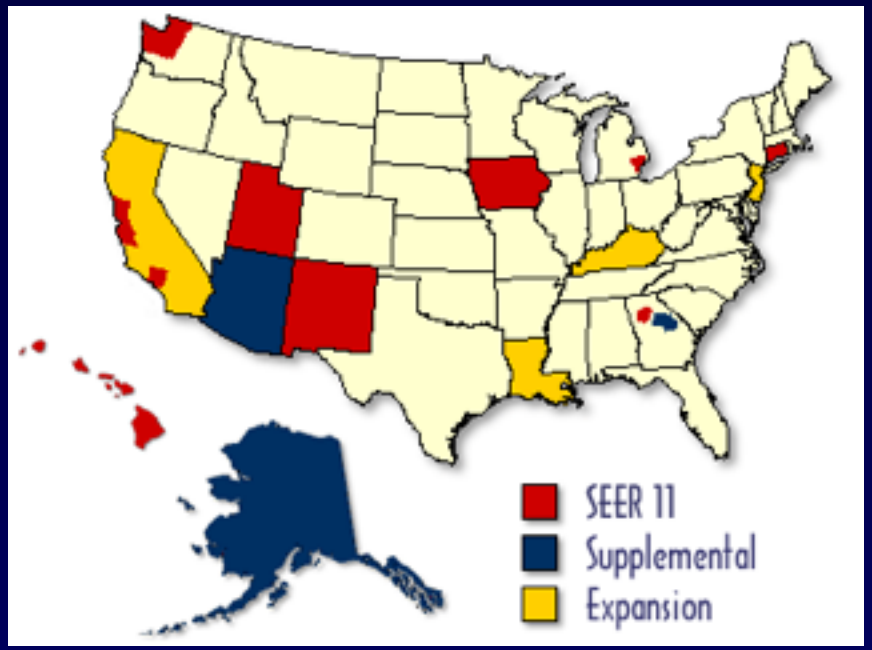
Cancer Incidence

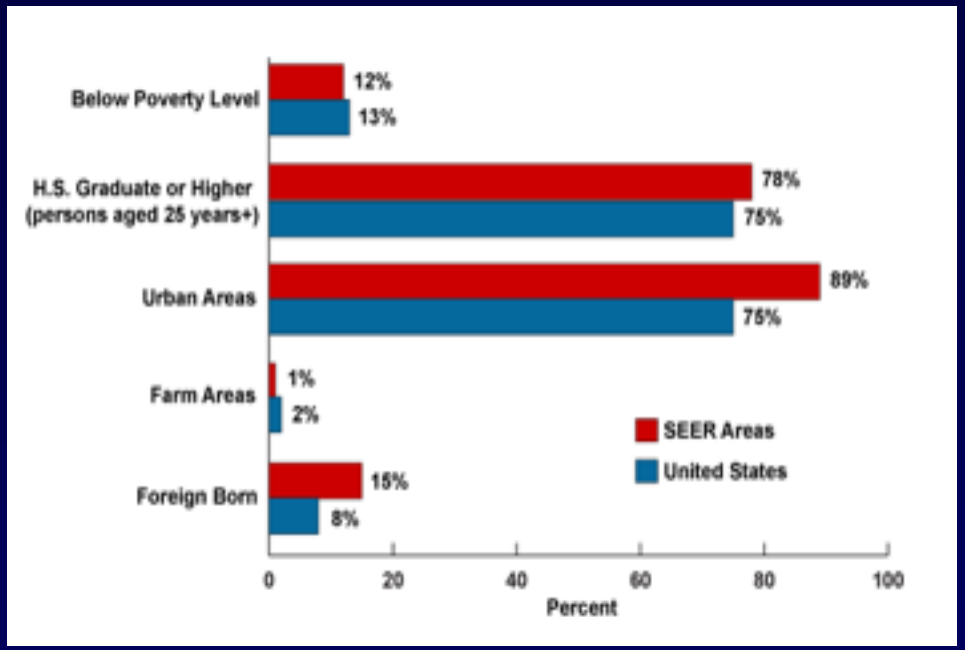
The number of newly diagnosed cases for a specific cancer or for all cancers combined during a specific time period

Cancer Prevalence

The number of current cases for a specific cancer or for all cancers combined during a specific time period

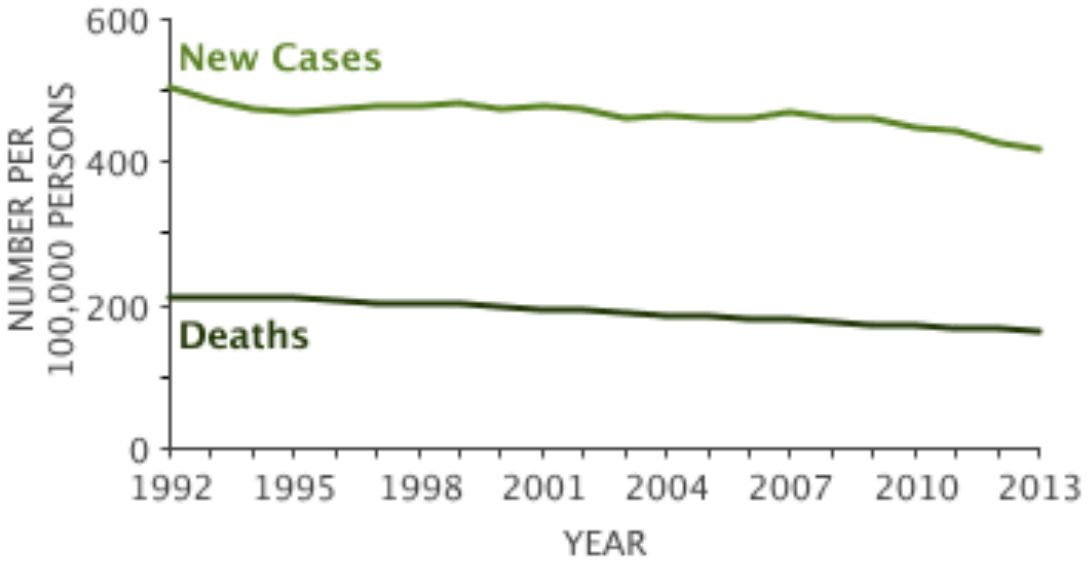
Surveillance, Epidemiology, and End Results (SEER) Program





2016 Estimated Stats

Estimated New Cases in 2016	1,685,210
% of All New Cancer Cases	100.0%
Estimated Deaths in 2016	595,690
% of All Cancer Deaths	100.0%



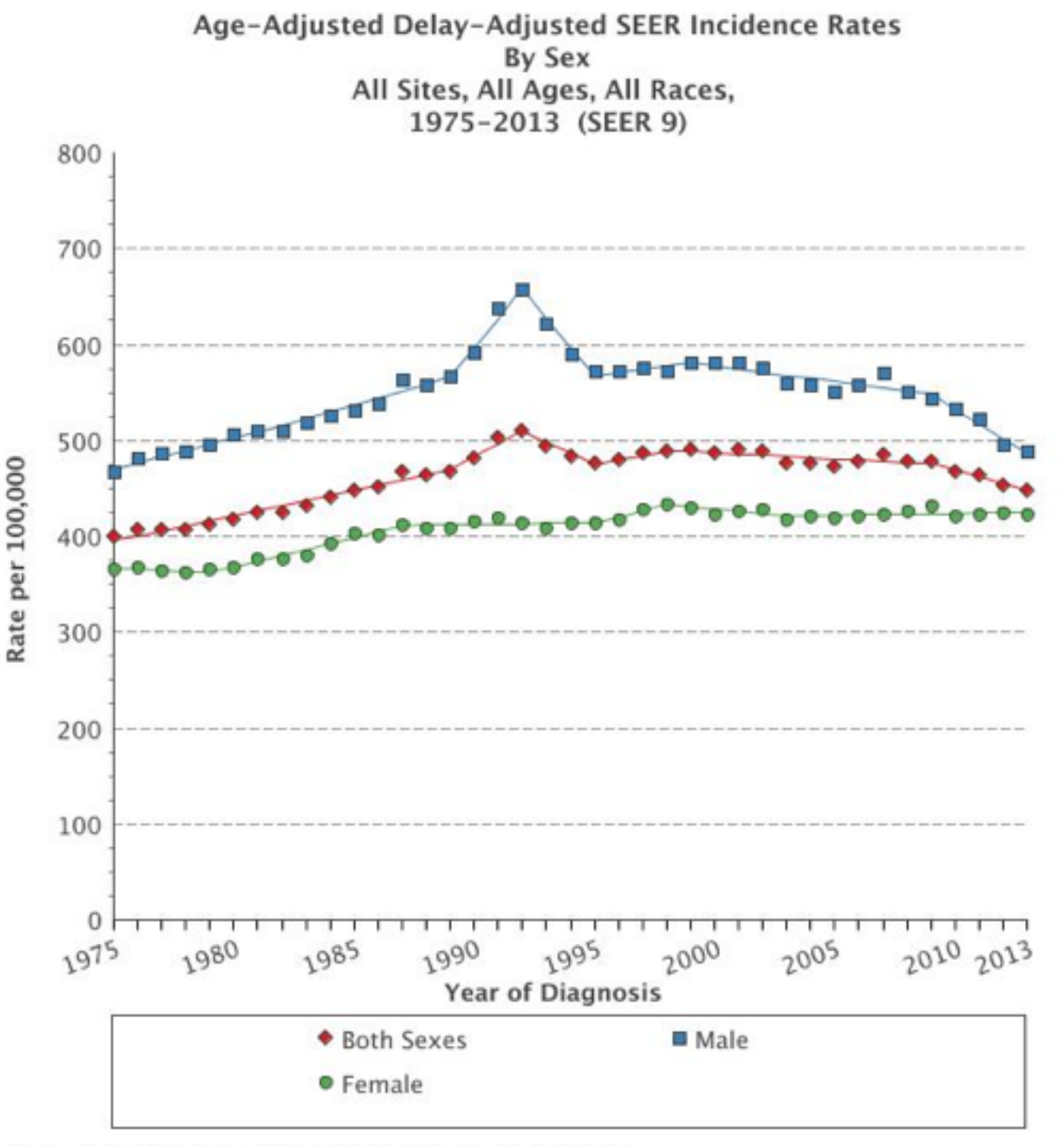
Percent Surviving 5 Years
66.9%
2006–2012

http://seer.cancer.gov/statfacts/html/all.html

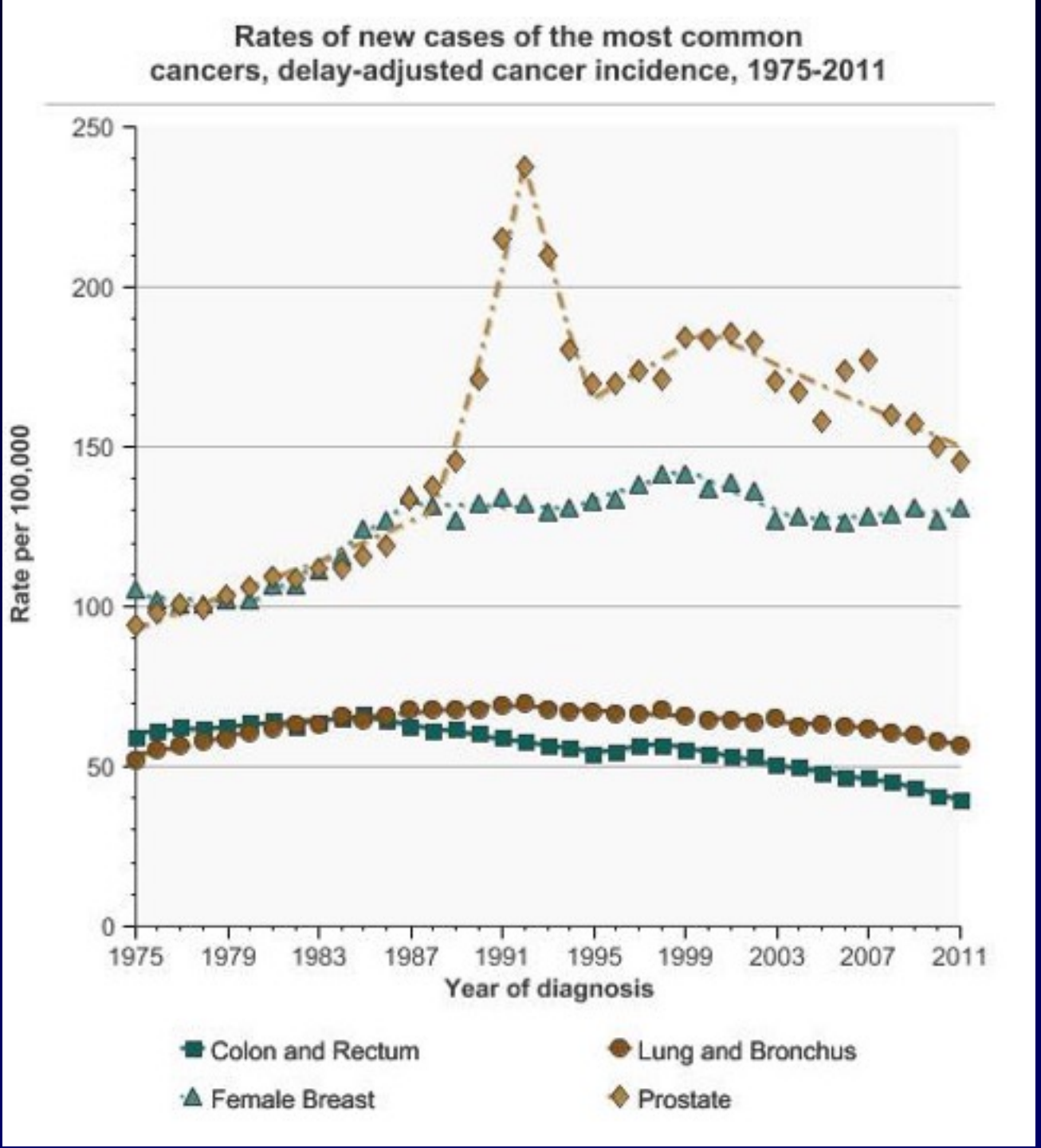
2016 Estimated Stats

	Common Types of Cancer	Estimated New Cases 2016	Estimated Deaths 2016
1.	Breast Cancer (Female)	246,660	40,450
2.	Lung and Bronchus Cancer	224,390	158,080
3.	Prostate Cancer	180,890	26,120
4.	Colon and Rectum Cancer	134,490	49,190
5.	Bladder Cancer	76,960	16,390
6.	Melanoma of the Skin	76,380	10,130
7.	Non-Hodgkin Lymphoma	72,580	20,150
8.	Thyroid Cancer	64,300	1,980
9.	Kidney and Renal Pelvis Cancer	62,700	14,240
10.	Leukemia	60,140	24,400
	–	–	–
	Cancer of Any Site	**1,685,210**	**595,690**

http://seer.cancer.gov/statfacts/html/all.html



Source: SEER Program, NCI, Incidence data from SEER 9 areas (http://seer.cancer.gov/registries/terms.html)
Age adjusted to the 2000 US census



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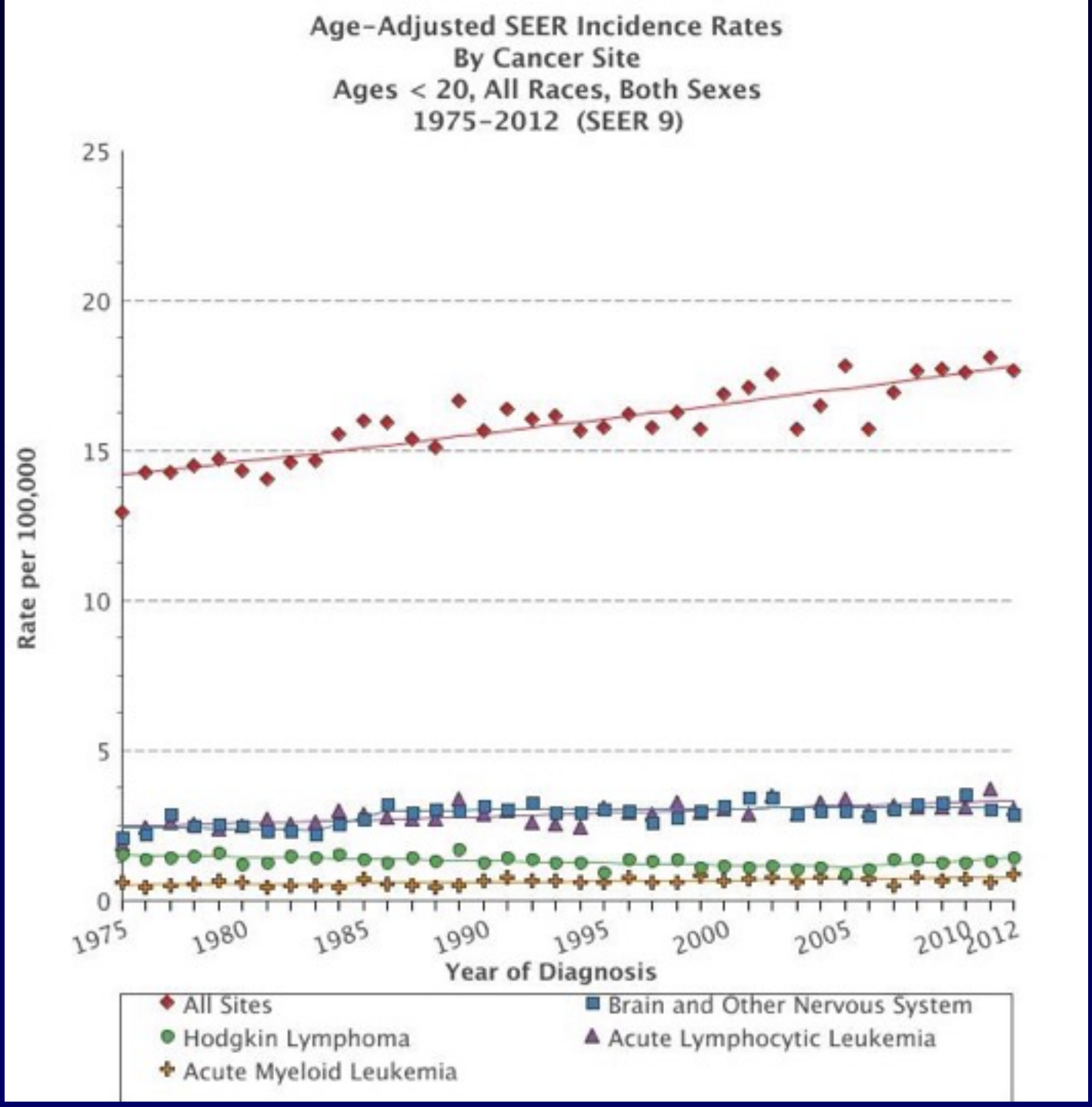

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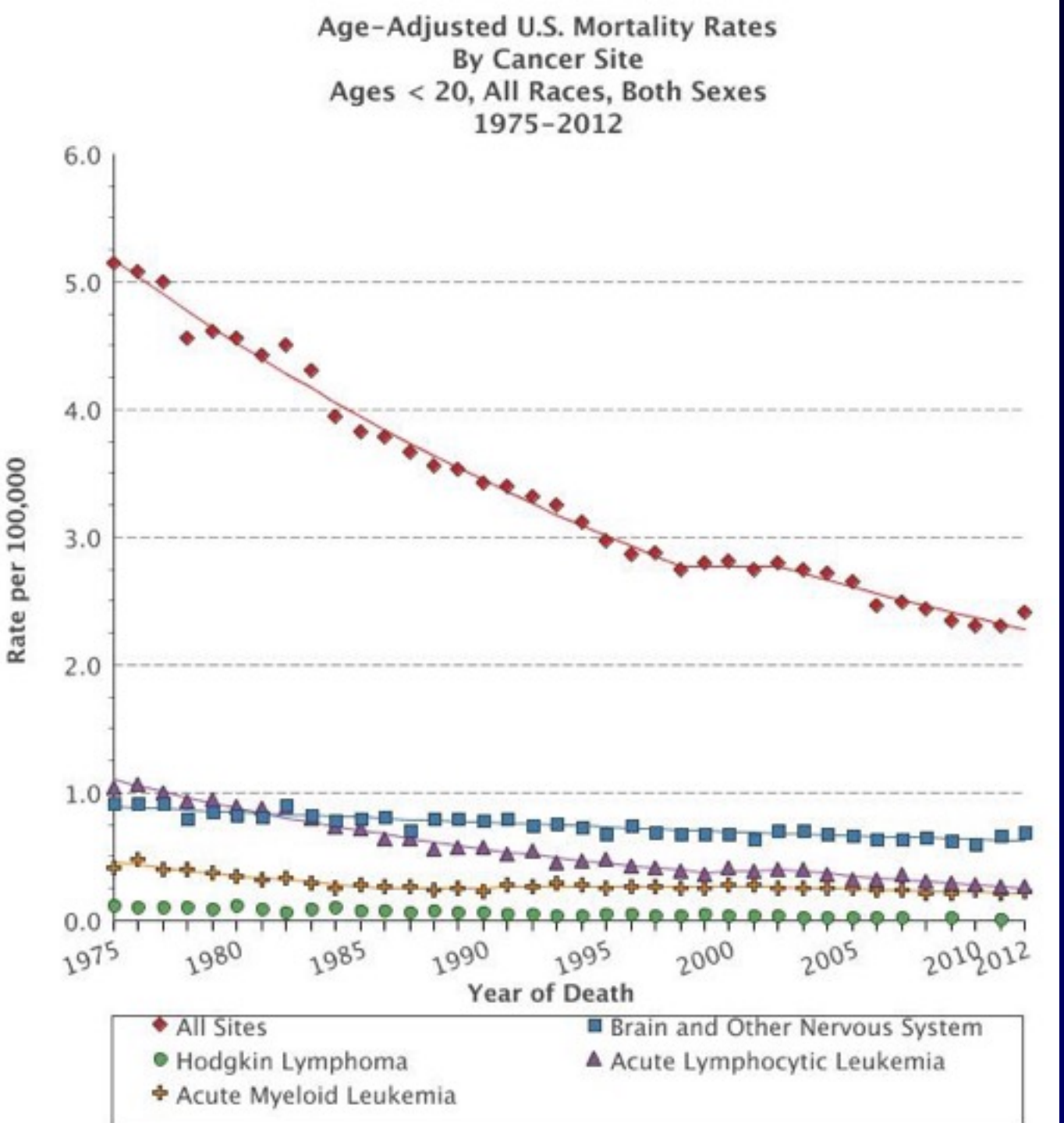


Source: SEER Program, NCI, Incidence data from SEER 9 areas (http://seer.cancer.gov/registries/terms.html) Age adjusted to the 2000 US census

Cancer Mortality

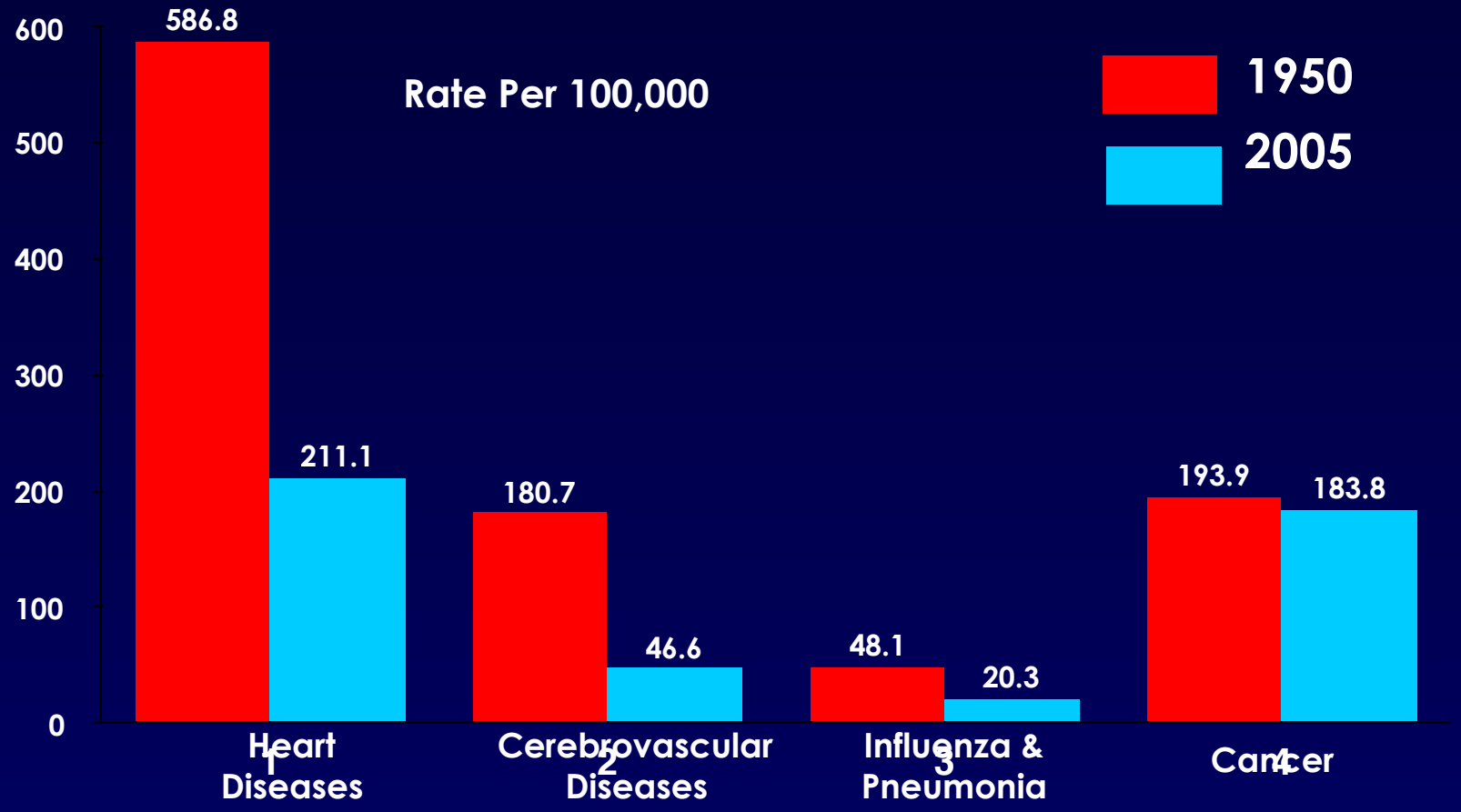
The number of deaths for a specific cancer or for all cancers combined during a specific time period

US Mortality, 2014

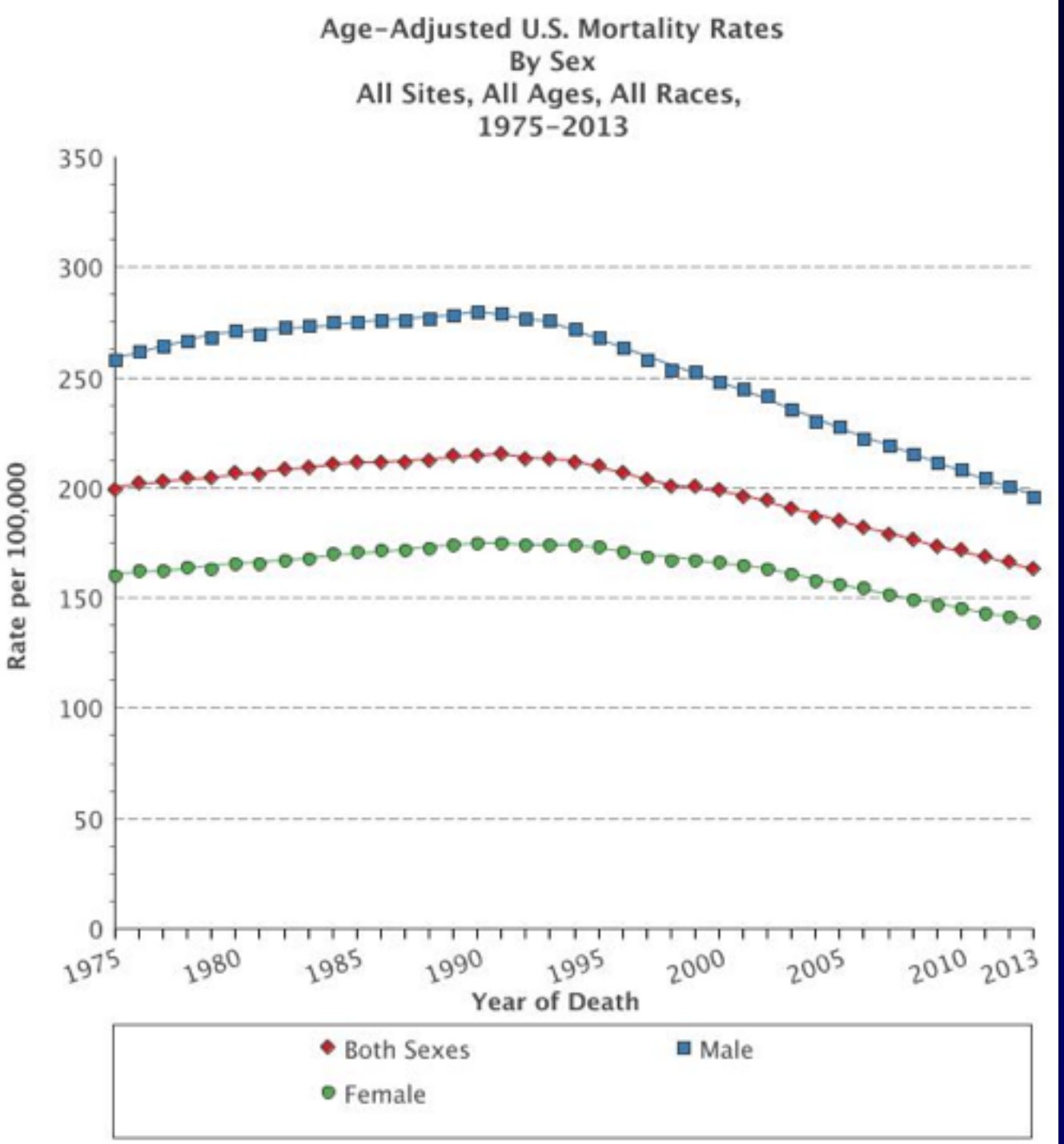
Rank	Cause of Death	# of deaths	% of all deaths
1.	Heart Diseases	614,348	23.4
2.	Cancer	591,699	22.5
3.	Chronic lower respiratory diseases	147,101	5.6
4.	Accidents (unintentional injuries)	136,053	5.2
5.	Cerebrovascular diseases	133,103	5.1
6.	Alzheimer disease	93,541	3.6
7.	Diabetes mellitus	76,488	2.9
8.	Influenza & pneumonia	55,227	2.1
•	Nephritis, nephrotic synd, nephrosis	48,146	1.8
10.	Intentional harm (suicide)	42,773	1.6

http://www.cdc.gov/nchs/data/dvs/LCWK9_2013.pdf

Change in the US Death Rates* by Cause, 1950 & 2005

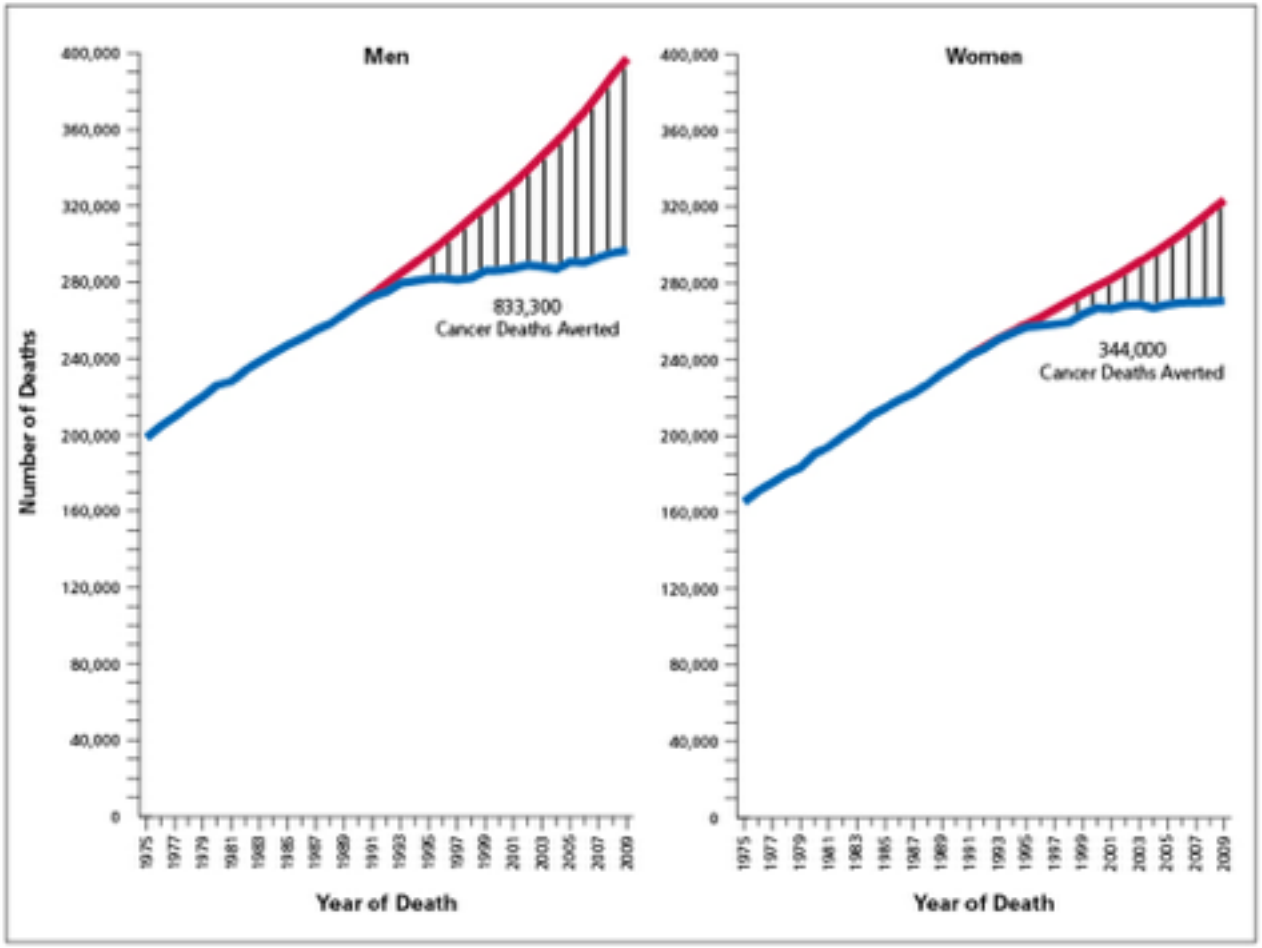


* Age-adjusted to 2000 US standard population.
Sources: 1950 Mortality Data - CDC/NCHS, NVSS, Mortality Revised.
2005 Mortality Data: US Mortality Data 2005, NCHS, Centers for Disease Control and Prevention, 2008.



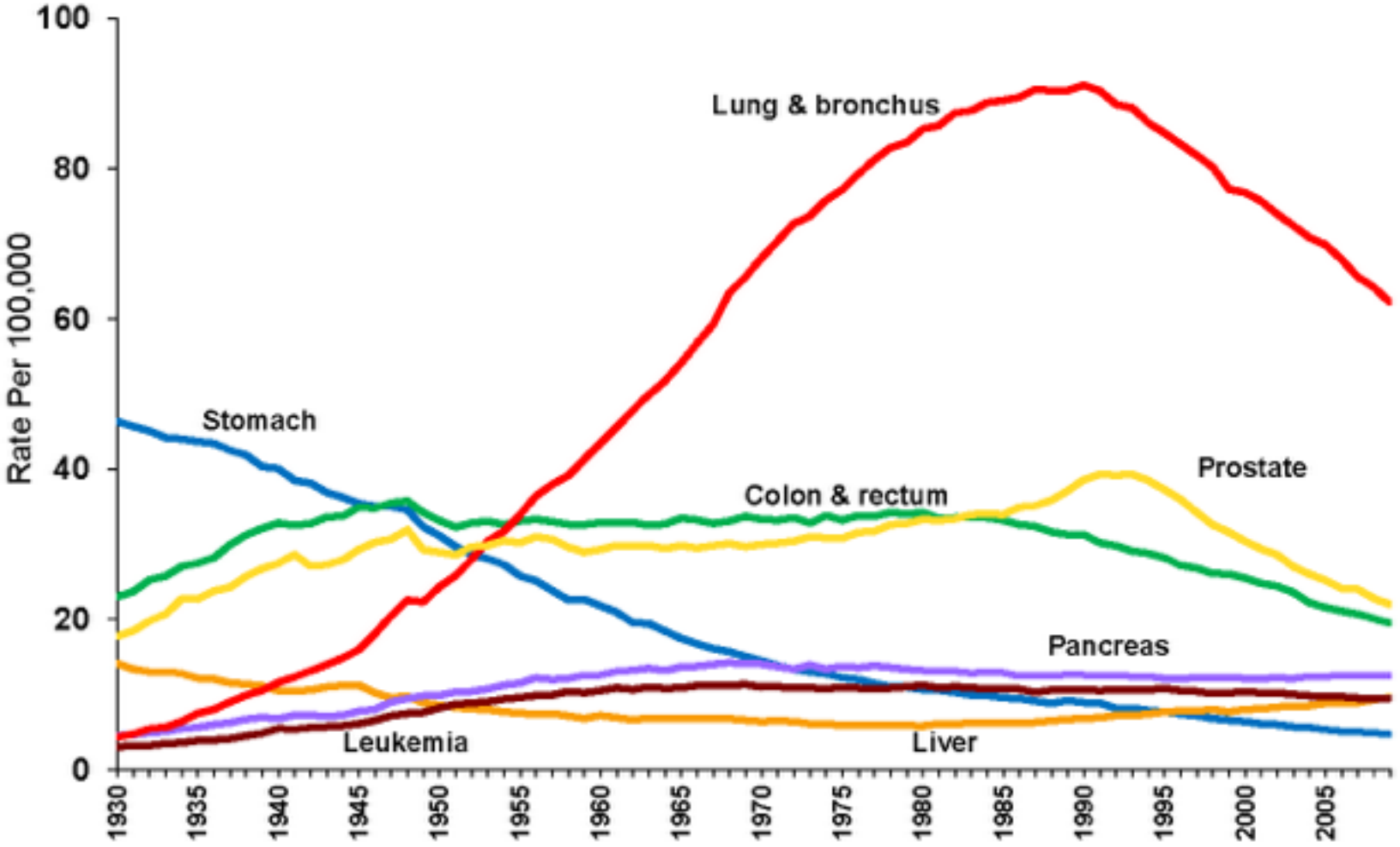
Source: SEER Program, NCI, Incidence data from SEER 9 areas (http://seer.cancer.gov/registries/terms.html) Age adjusted to the 2000 US census

Total Number of Cancer Deaths Averted from 1991 to 2009 in Men and 1992 to 2009 in Women



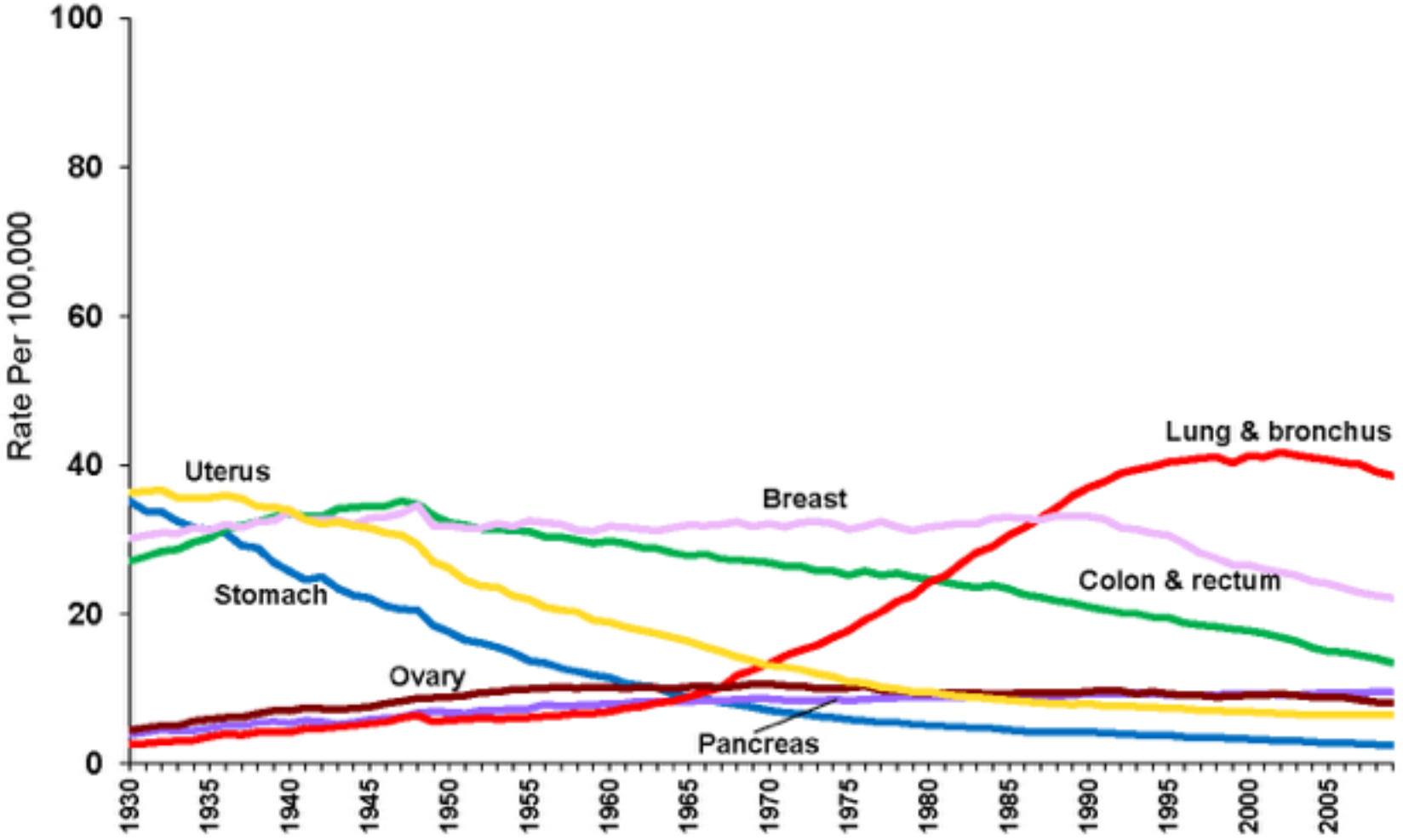
The blue line represents the actual number of cancer deaths recorded in each year, and the red line represents the number of cancer deaths that would have been expected if cancer death rates had remained at their peak.

Cancer Death Rates* Among Men, US,1930-2009



*Age-adjusted to the 2000 US standard population.
Source: US Mortality Data 1960-2009, US Mortality Volumes 1930-1959,
National Center for Health Statistics, Centers for Disease Control and Prevention.

Cancer Death Rates* Among Women, US,1930-2009



*Age-adjusted to the 2000 US standard population.
Source: US Mortality Data 1960-2009, US Mortality Volumes 1930-1959,
National Center for Health Statistics, Centers for Disease Control and Prevention.

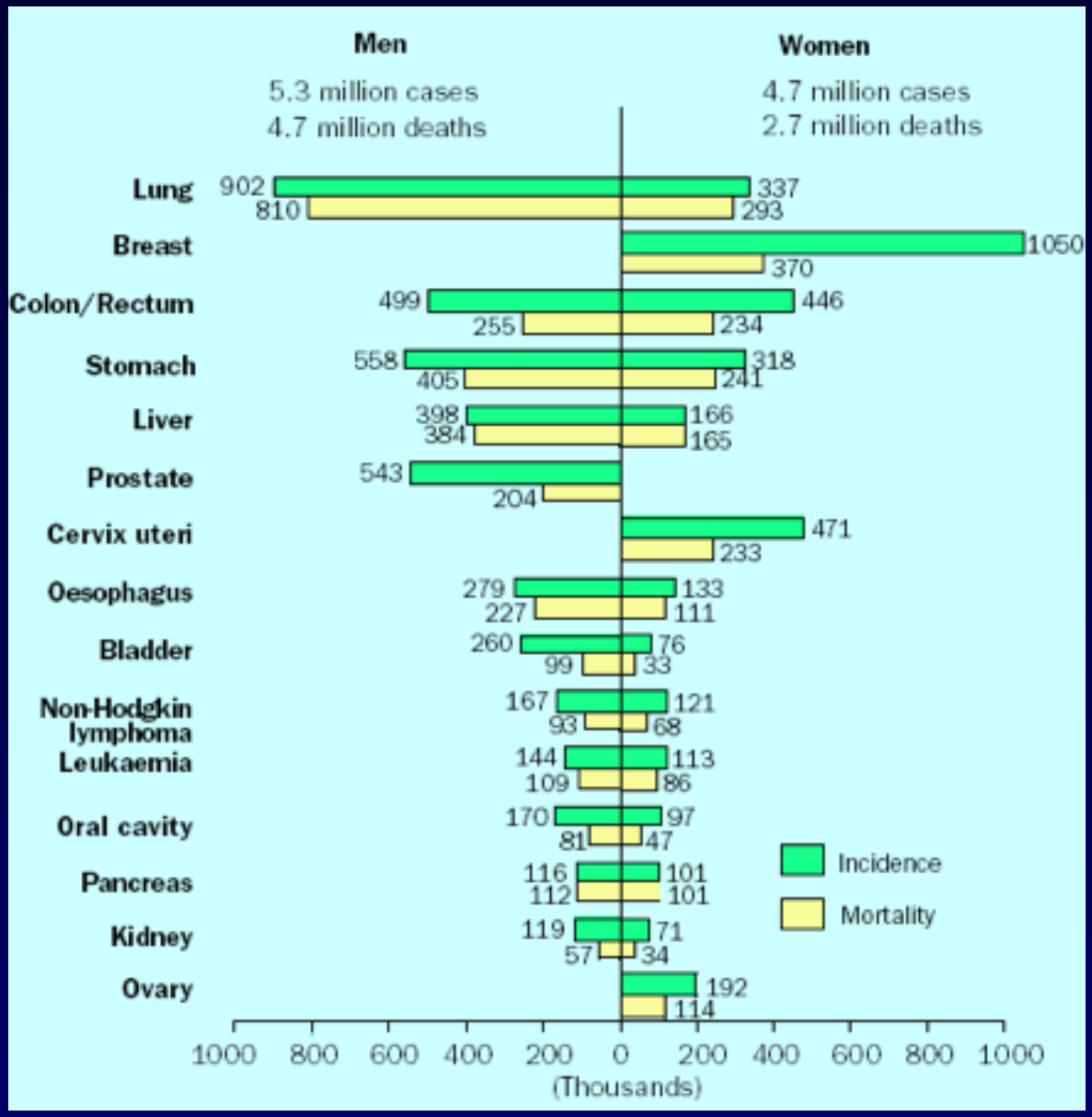
Trends in Five-year Relative Cancer Survival Rates (%), 1975-2008

Site	1975-1977	1987-1989	2002-2008
All sites	49	56	68
Breast (female)	75	84	90
Colon	51	61	65
Leukemia	34	43	58
Lung & bronchus	12	13	17
Melanoma	82	88	93
Non-Hodgkin lymphoma	47	51	71
Ovary	36	38	43
Pancreas	2	4	6
Prostate	68	83	100
Rectum	48	58	68
Urinary bladder	73	79	80

5-year relative survival rates based on patients diagnosed from 2002 to 2008, all followed through 2009.
Source: *SEER Cancer Statistics Review 1975-2009 (*SEER 9 registries), National Cancer Institute, 2012.

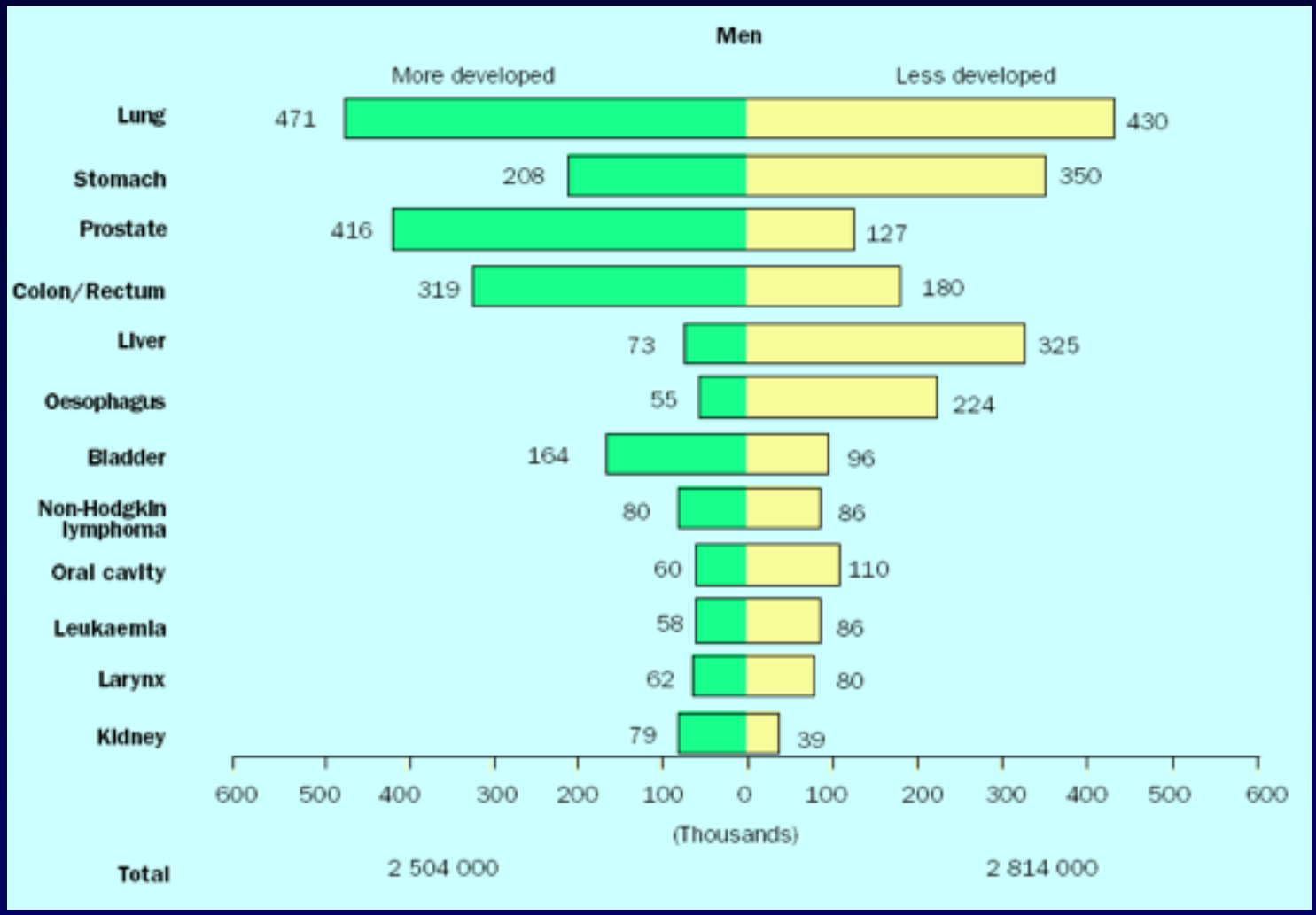
Geographic Variation

Estimated Numbers of New Cases and Deaths – by Sex and Site - 2000



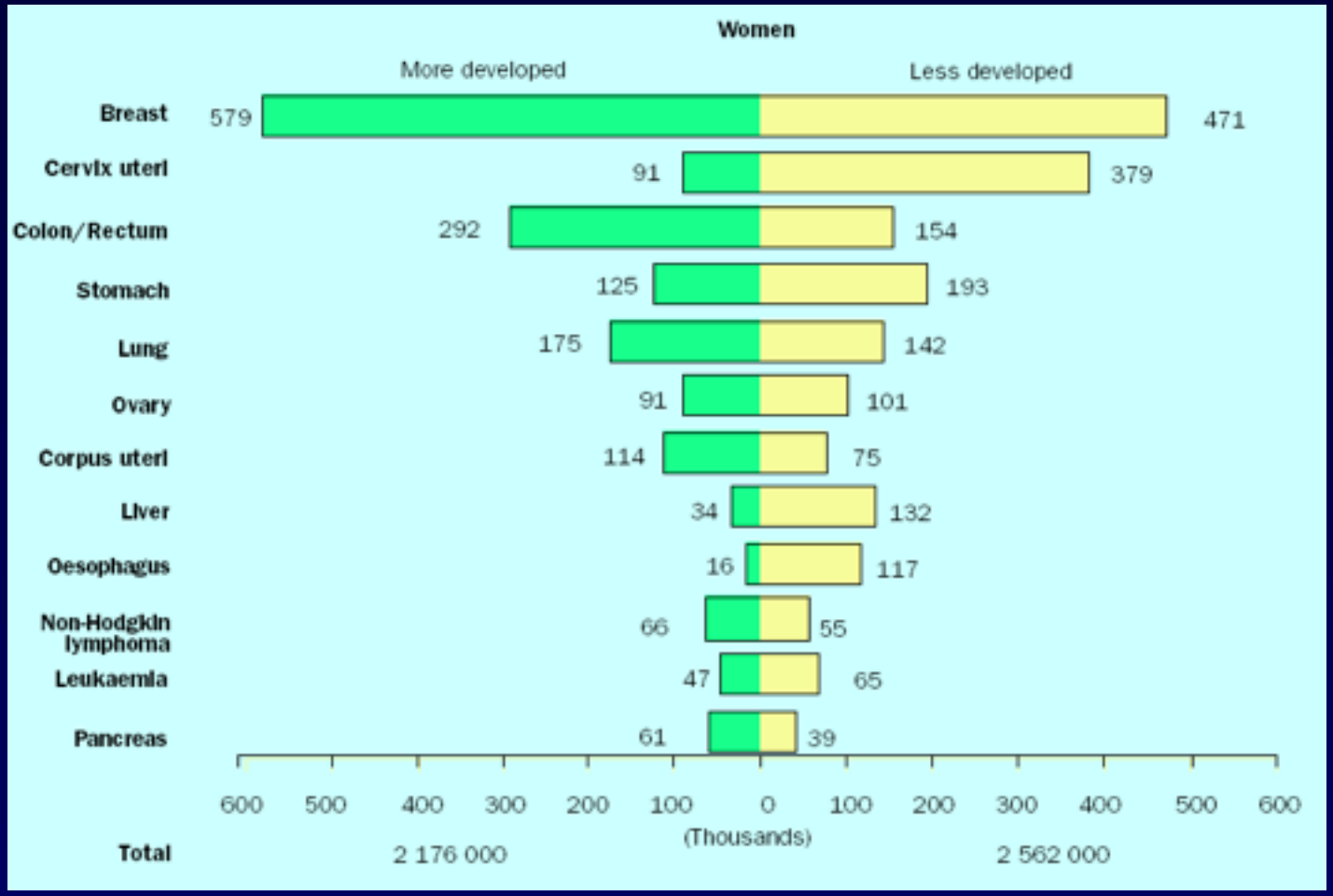
Source: Parkin DM *Lancet Oncol* 2001; 2: 533–43

Estimated Numbers of New Cases of the 12 Most Common Cancers in Developed and Developing Countries – Males - 2000



Source: Parkin DM *Lancet Oncol* 2001; 2: 533–43

Estimated Numbers of New Cases of the 12 Most Common Cancers in Developed and Developing Countries – Females - 2000

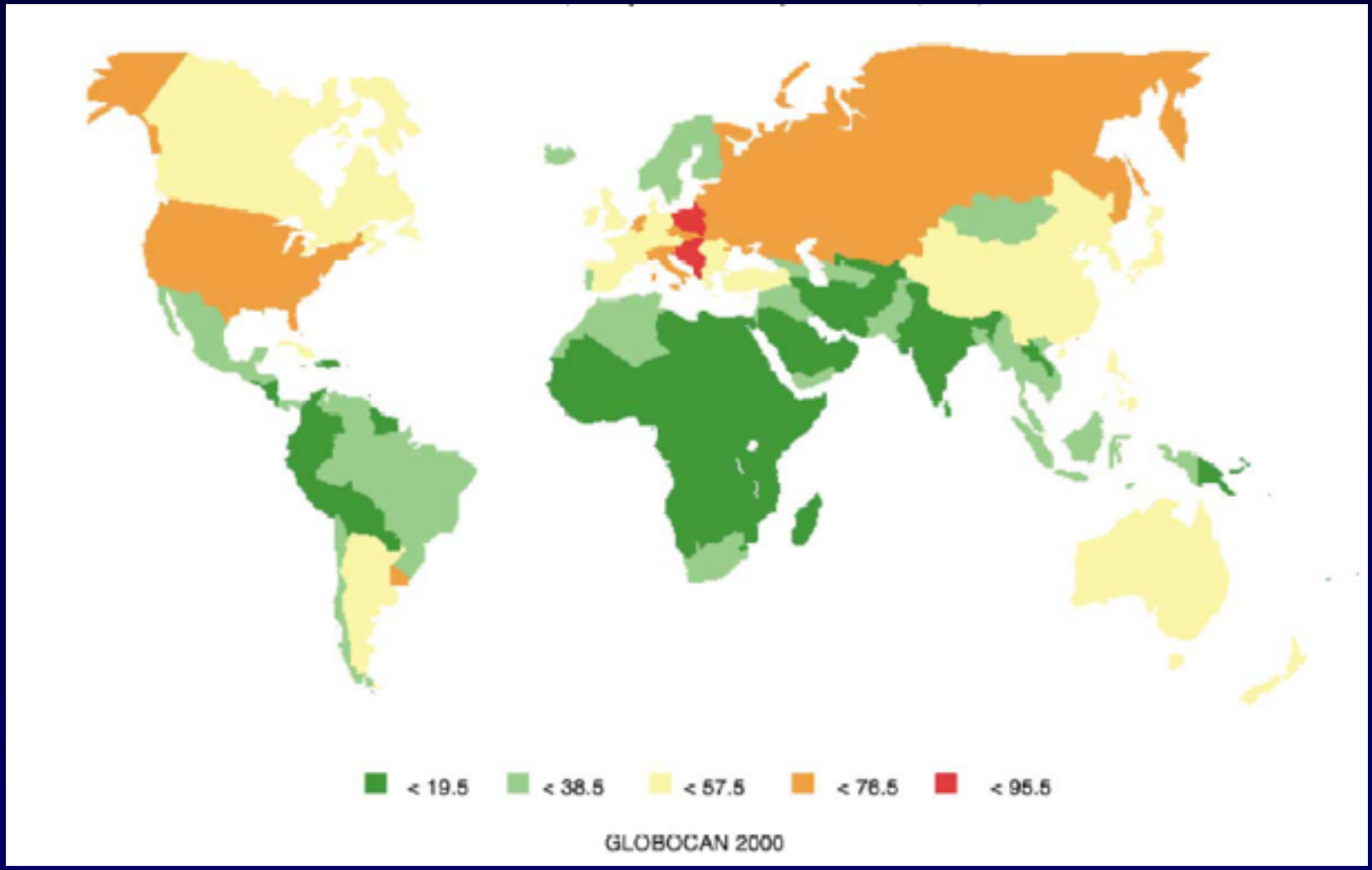


Source: Parkin DM *Lancet Oncol* 2001; 2: 533–43

Geographic Variation

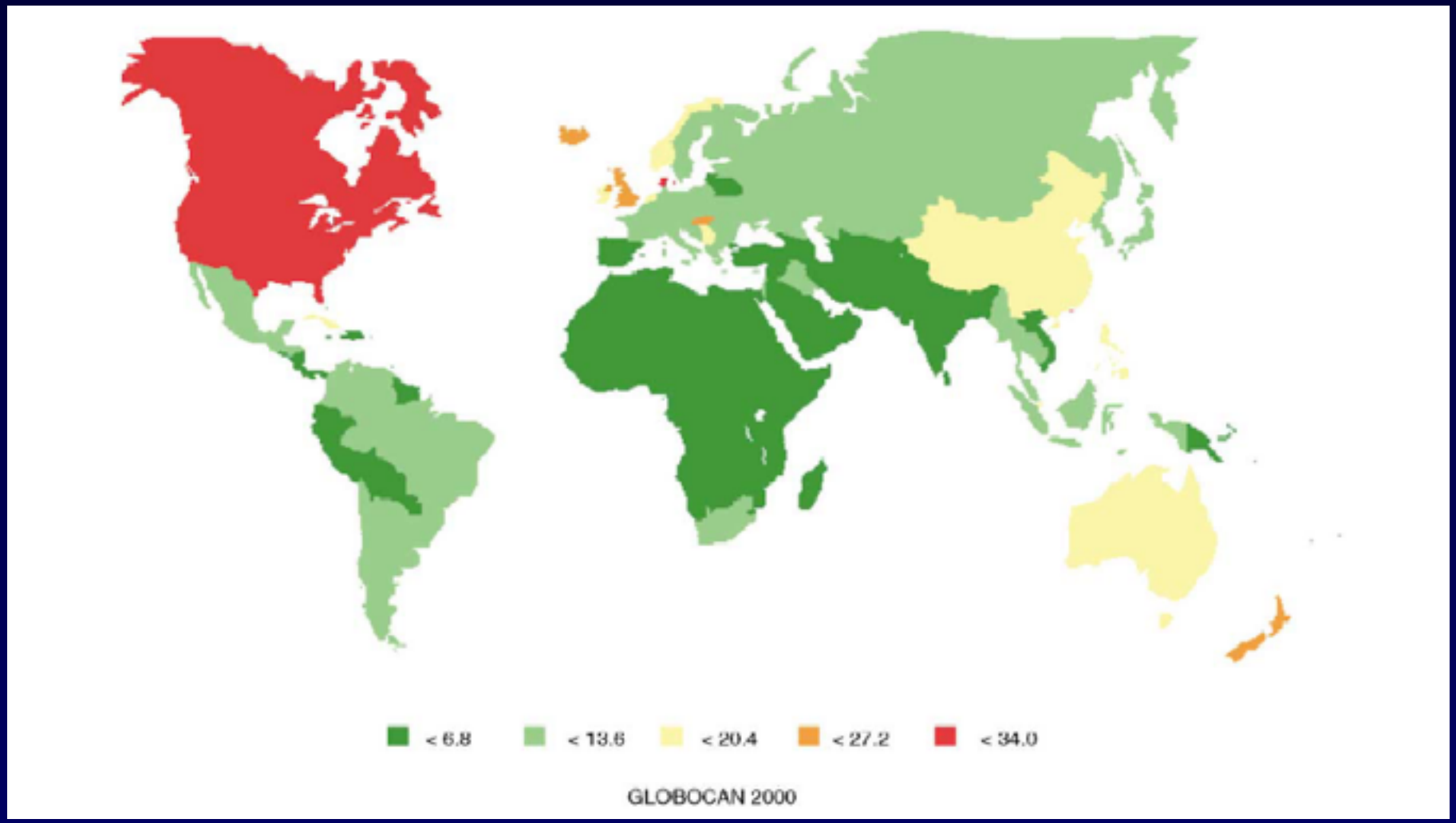
Exposure to Carcinogens

Incidence of Lung Cancer: Age-Standardized Rates Males -2000

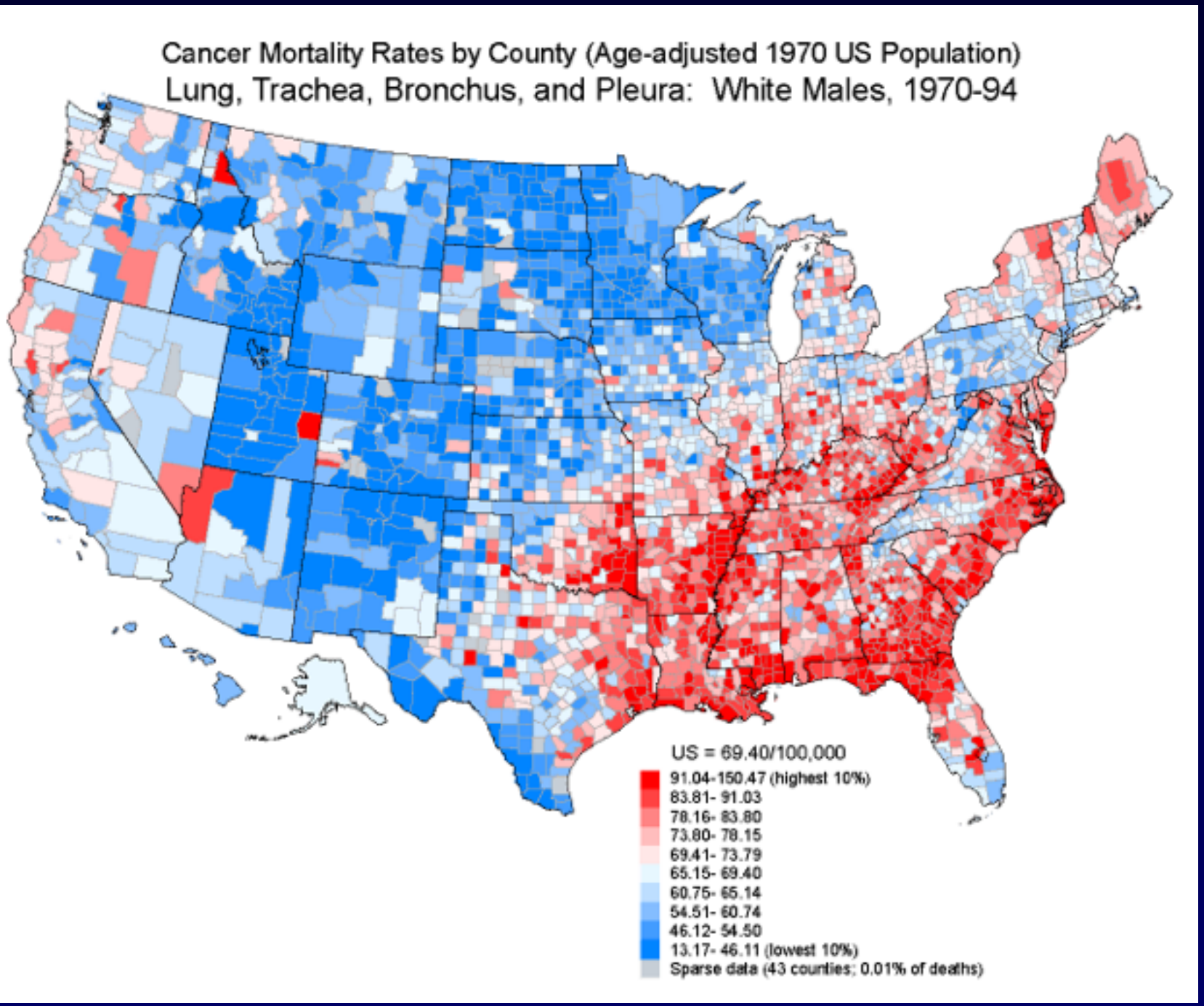


Source: Parkin et al. European Journal of Cancer 37 (2001) S4–S66

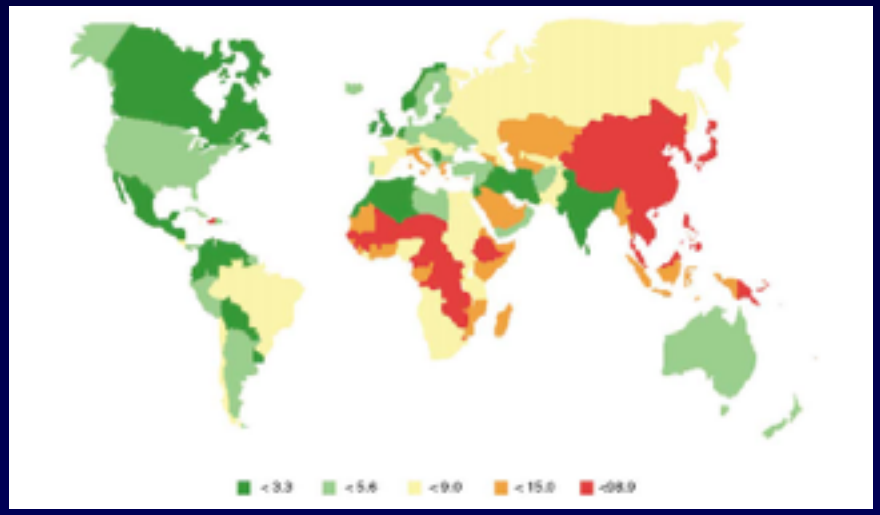
Incidence of Lung Cancer: Age-Standardized Rates Females - 2000



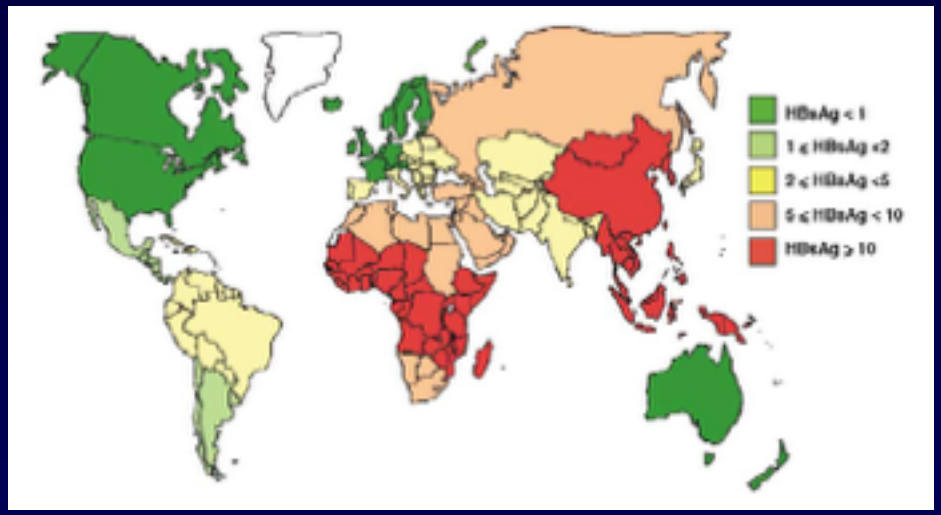
Source: Parkin et al. European Journal of Cancer 37 (2001) S4–S66


Cancer Mortality Rates by County (Age-adjusted 1970 US Population)
Lung, Trachea, Bronchus, and Pleura: White Males, 1970-94
US = 69.40/100,000
91.04-150.47 (highest 10%)
83.81- 91.03
78.16- 83.80
73.80- 78.15
69.41- 73.79
65.15- 69.40
60.75- 65.14
54.51- 60.74
46.12- 54.50
13.17- 46.11 (lowest 10%)
Sparse data (43 counties; 0.01% of deaths)

Incidence of Liver Cancer: Age-Standardized Rates - 2000



Prevalence of Hepatitis B Virus Surface Antigen Carriers

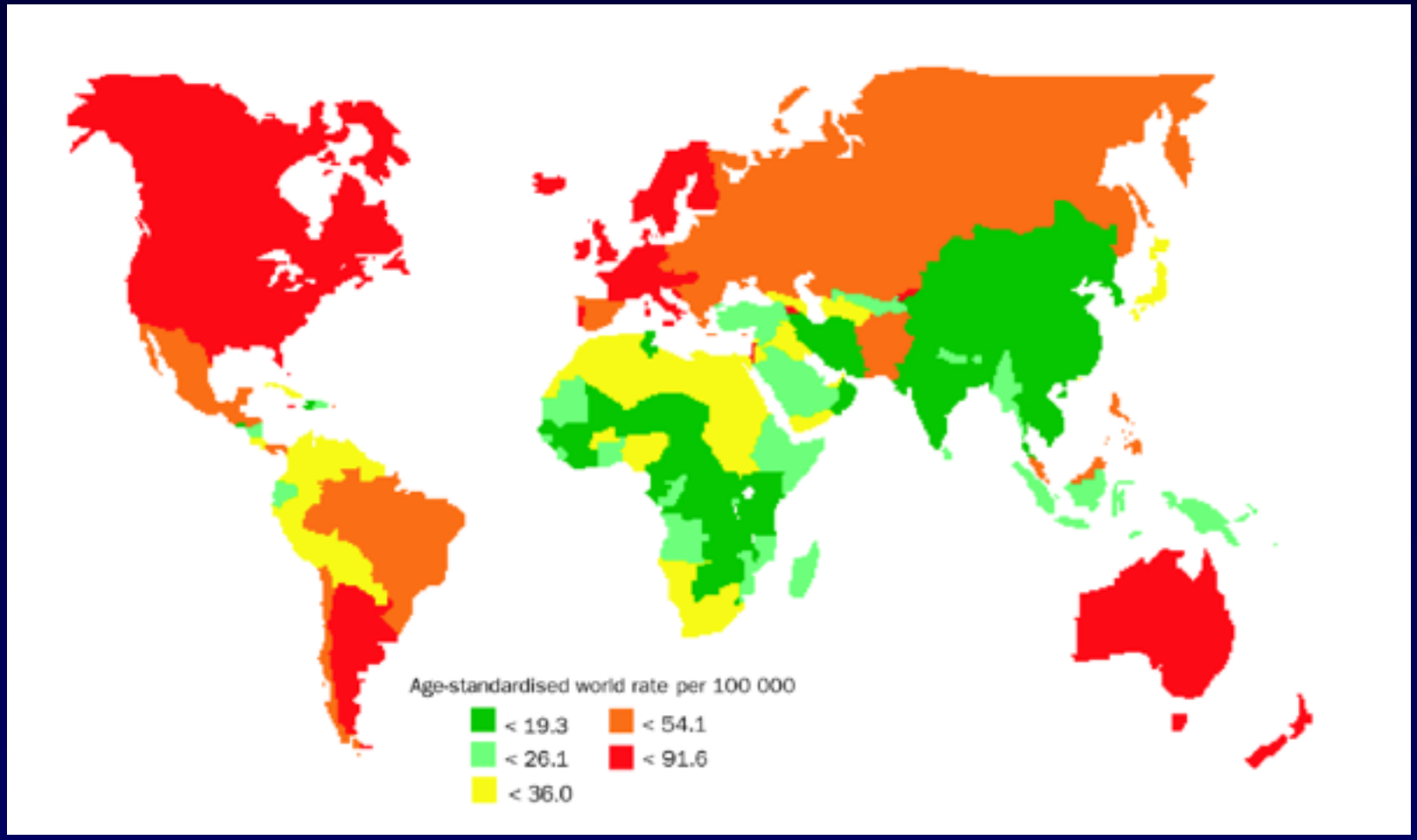


Source: Parkin et al. European Journal of Cancer 37 (2001) S4–S66

Geographic Variation

Lifestyle Factors

Incidence of Breast Cancer: Age-Standardized Rates- 2000



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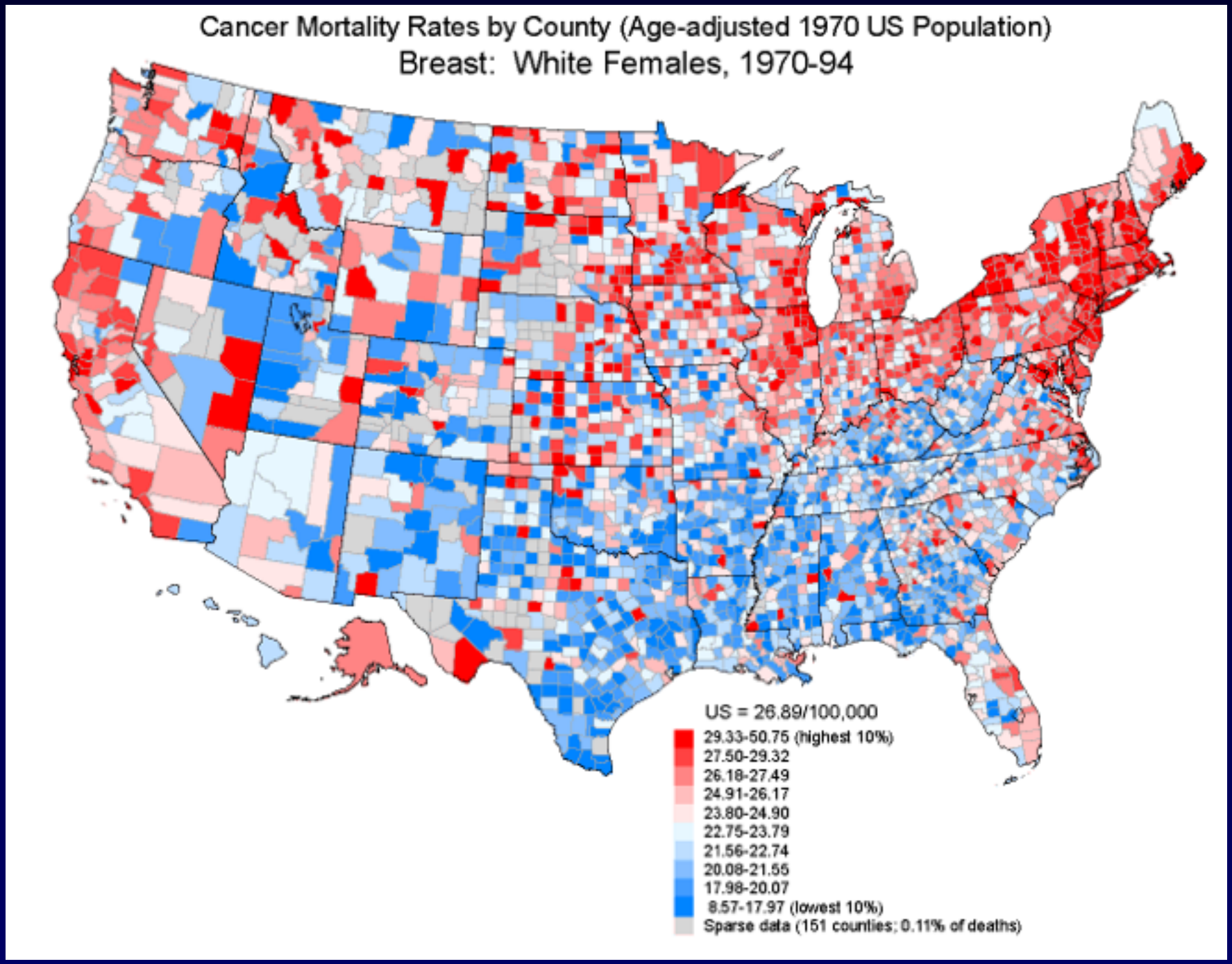
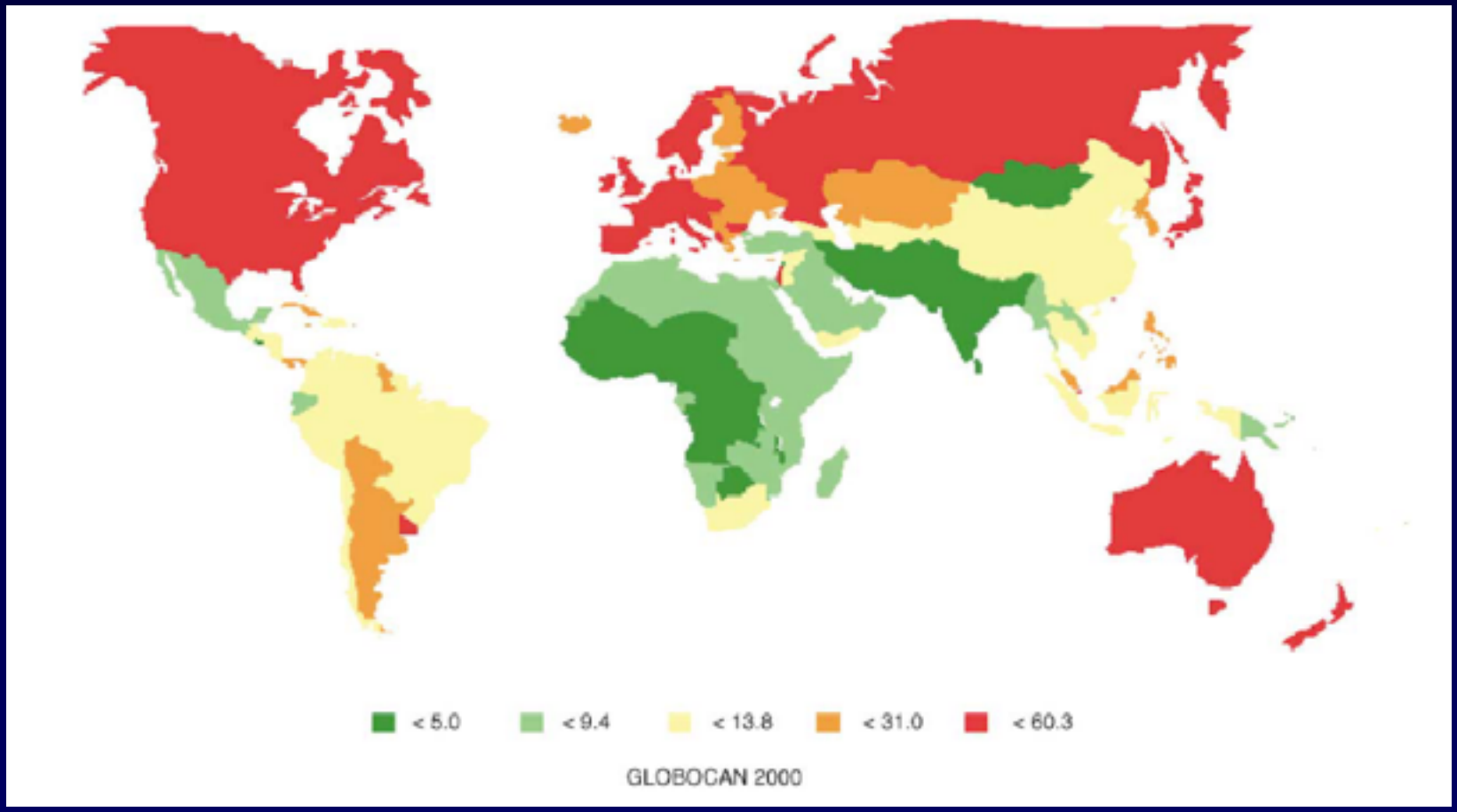
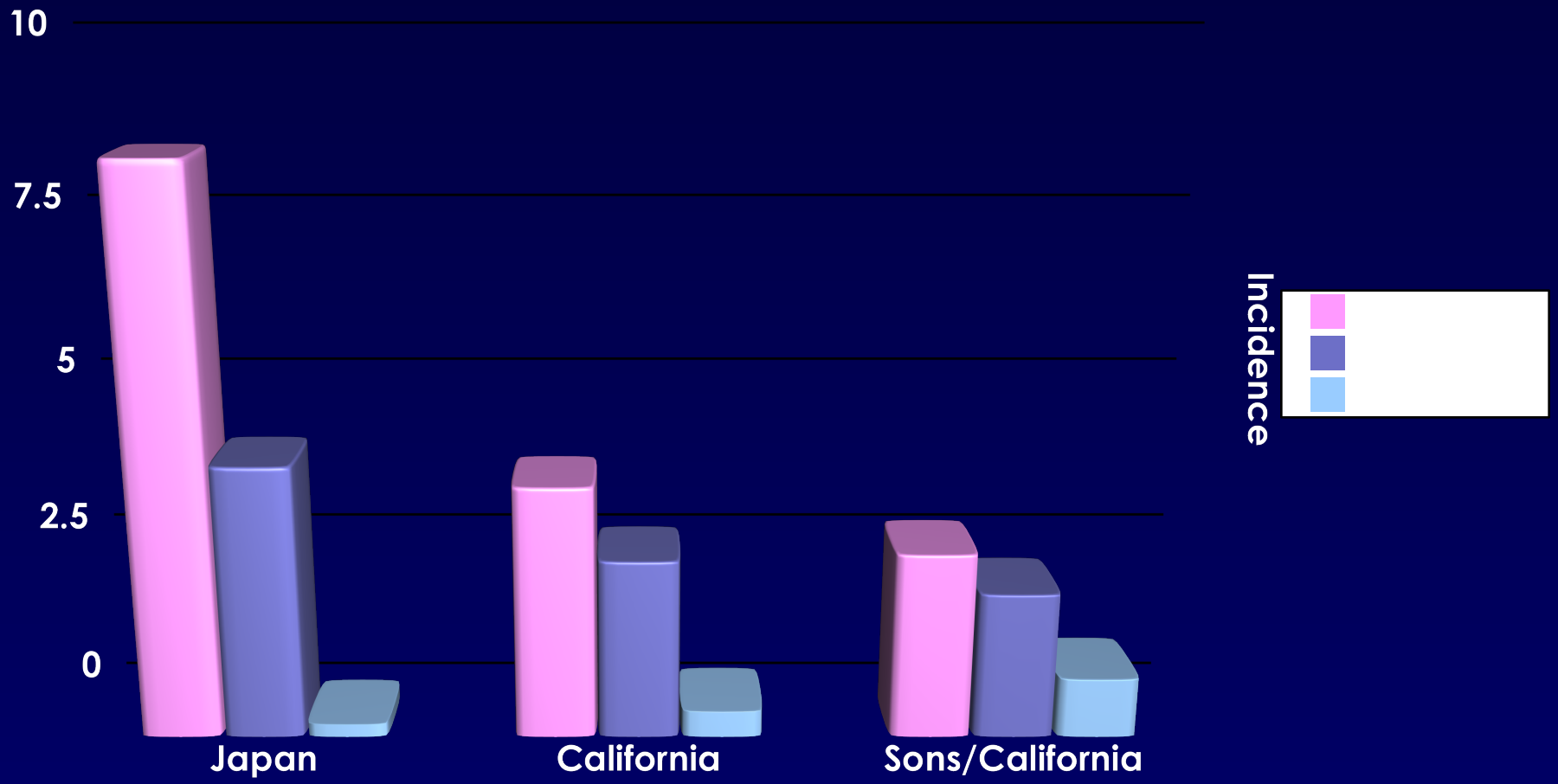

Cancer Mortality Rates by County (Age-adjusted 1970 US Population)
Breast: White Females, 1970-94
US = 26.89/100,000
29.33-50.75 (highest 10%)
27.50-29.32
26.18-27.49
24.91-26.17
23.80-24.90
22.75-23.79
21.56-22.74
20.08-21.55
17.98-20.07
8.57-17.97 (lowest 10%)
Sparse data (151 counties; 0.11% of deaths)

Incidence of Colorectal Cancer: Age-Standardized Rates- 2000

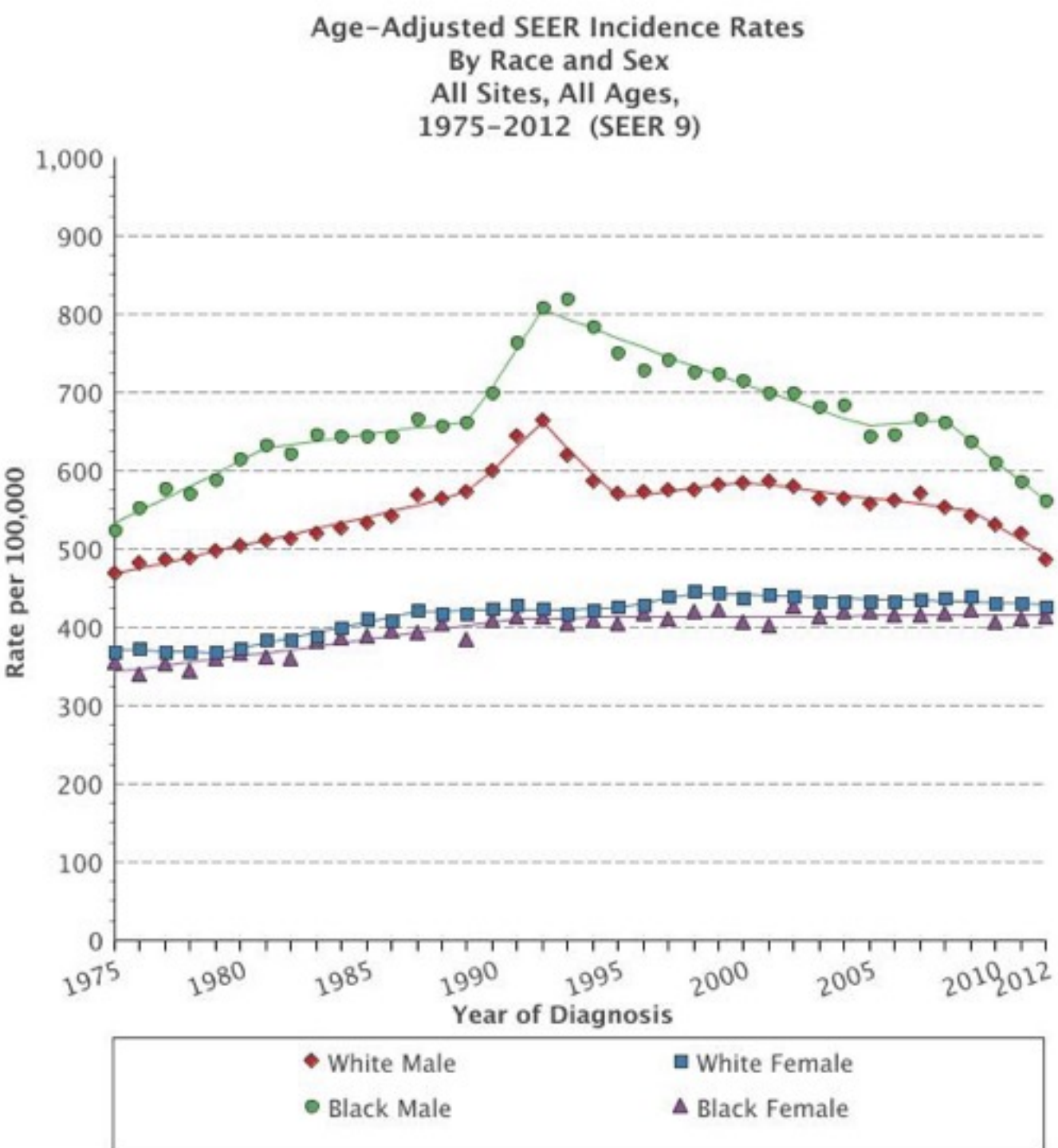


Source: Parkin et al. European Journal of Cancer 37 (2001) S4–S66

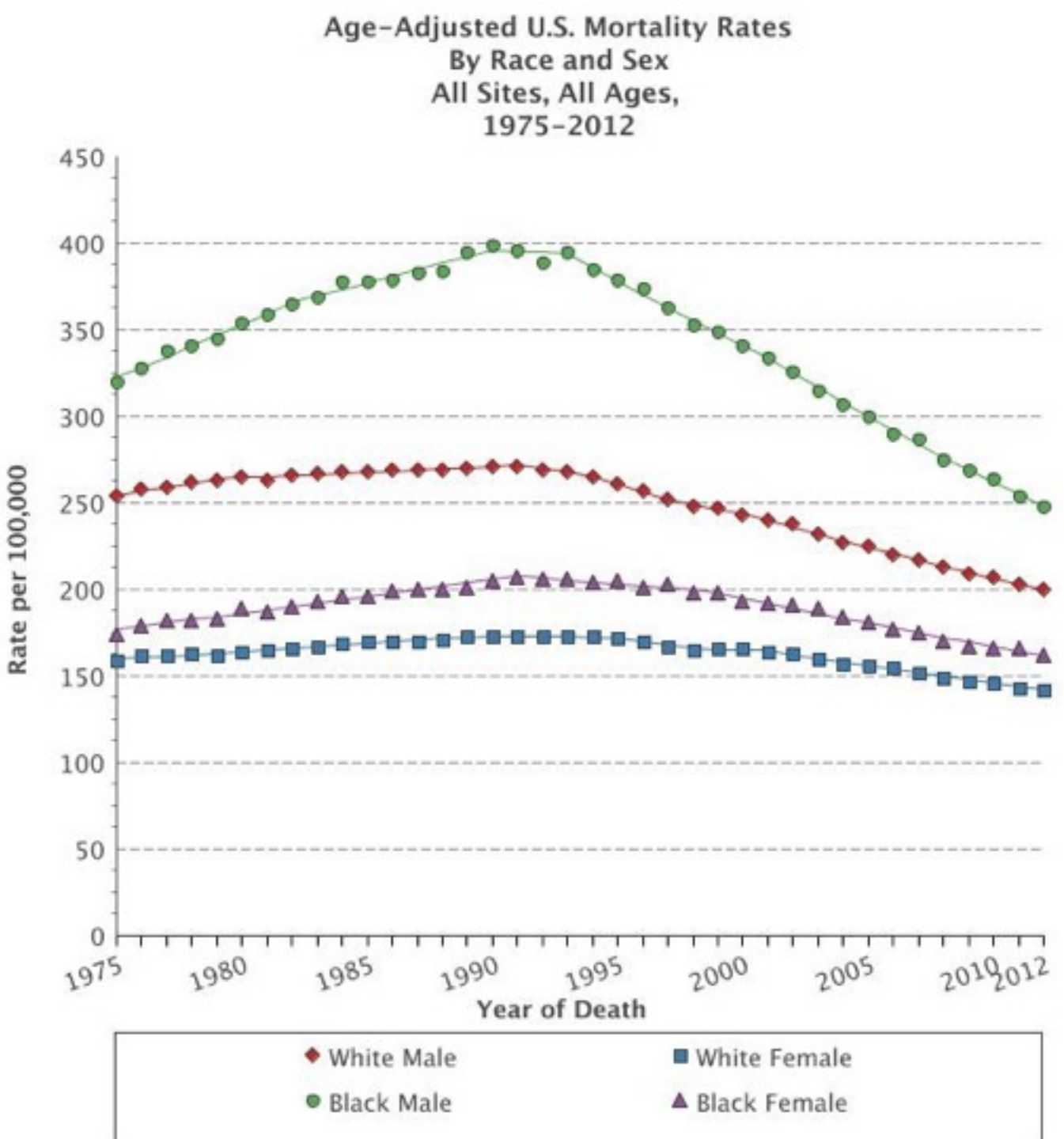
Relative risk of mortality from cancer of the stomach, liver, and colon among Japanese men in Japan, Japanese men in California, and sons of Japanese immigrants compared with white men in California



Racial Variation



Source: SEER Program, NCI, Incidence data from SEER 9 areas (http://seer.cancer.gov/registries/terms.html) Age adjusted to the 2000 US census



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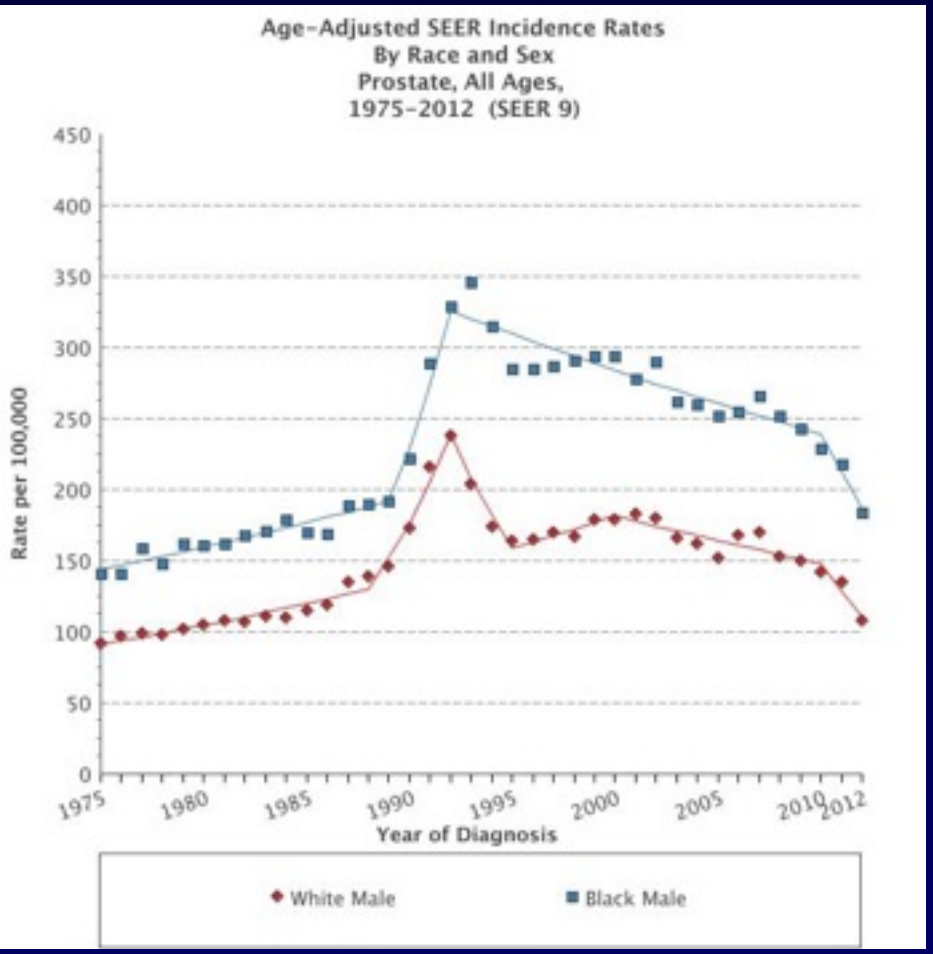
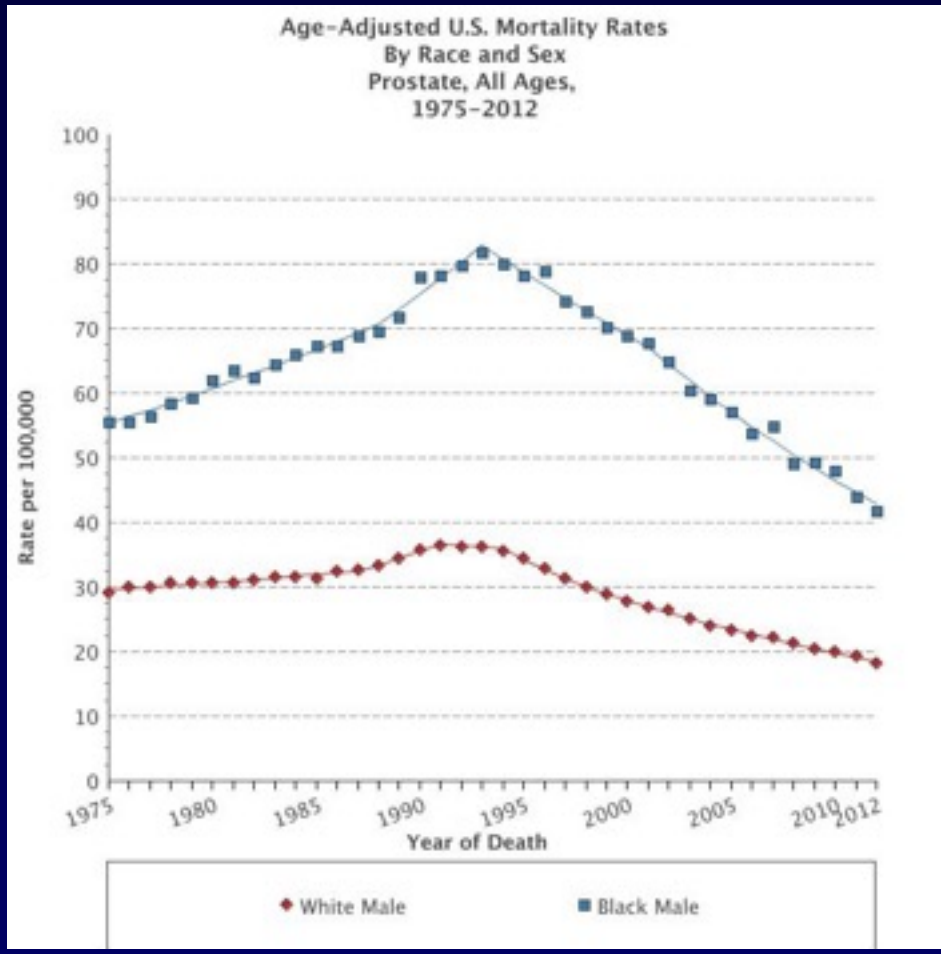
Prostate Cancer, by Race

Incidence

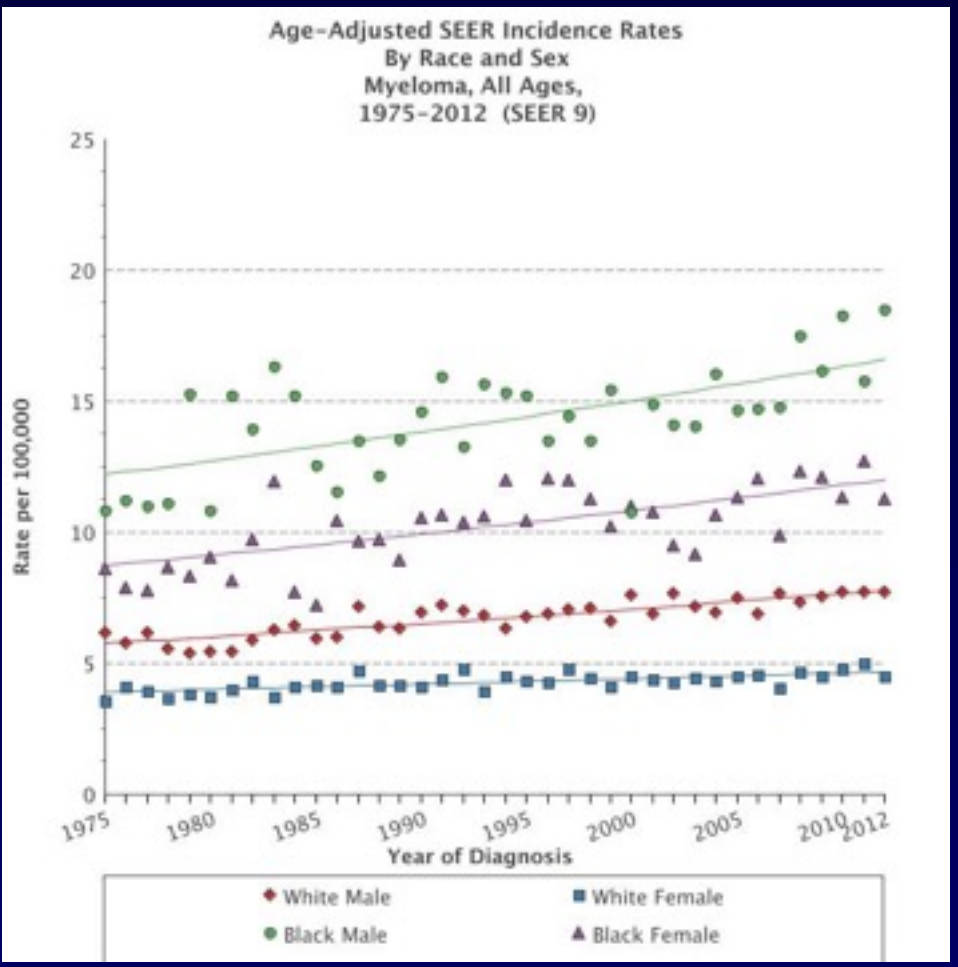


Mortality

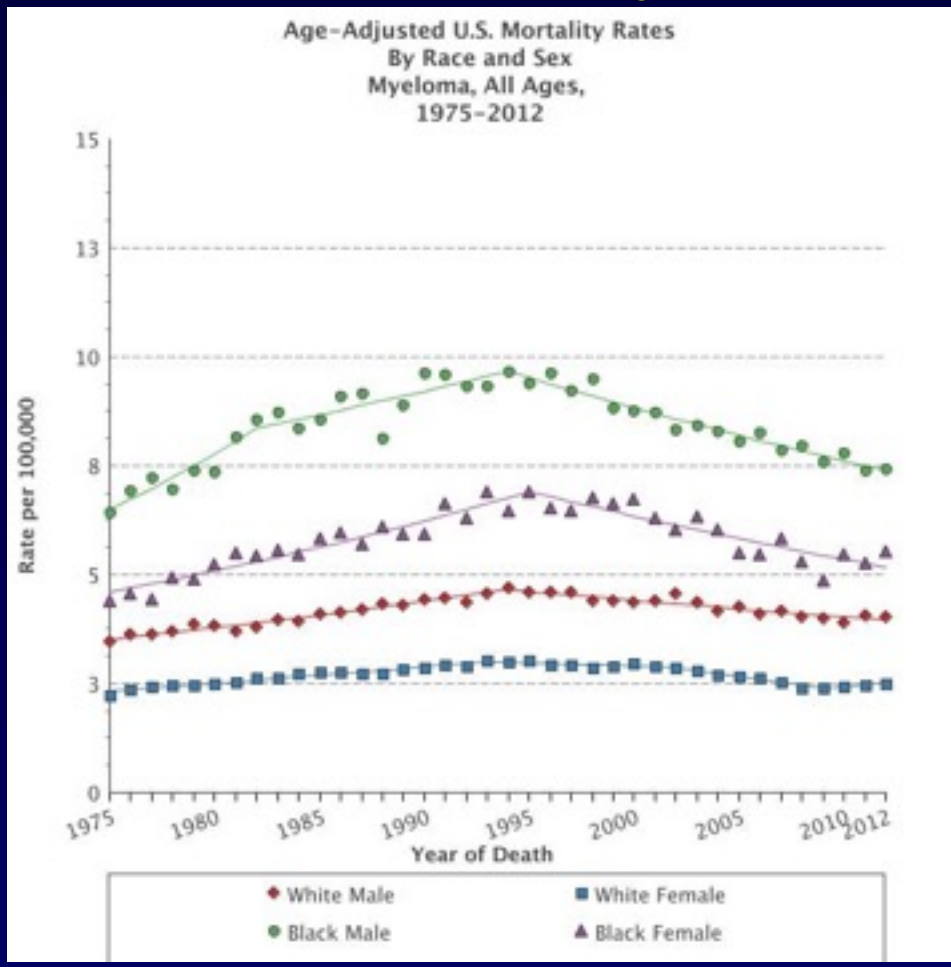


Multiple Myeloma, by Race & Sex

Incidence

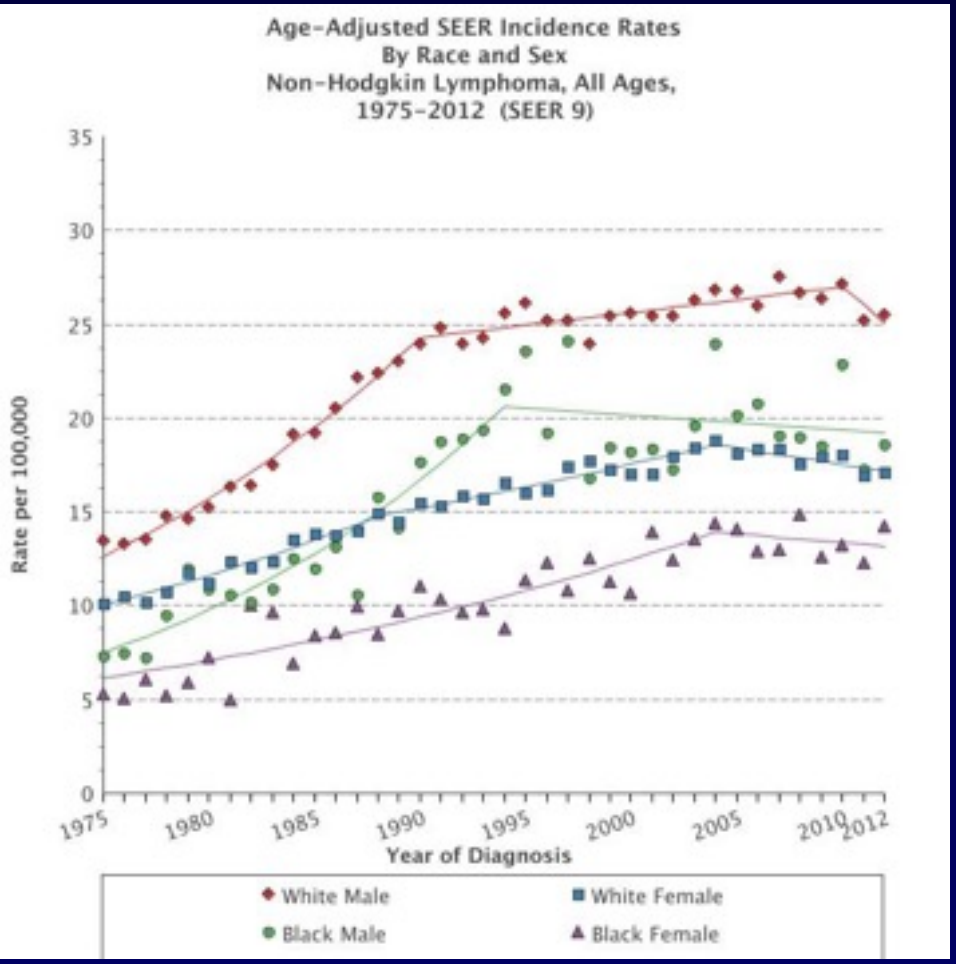


Mortality

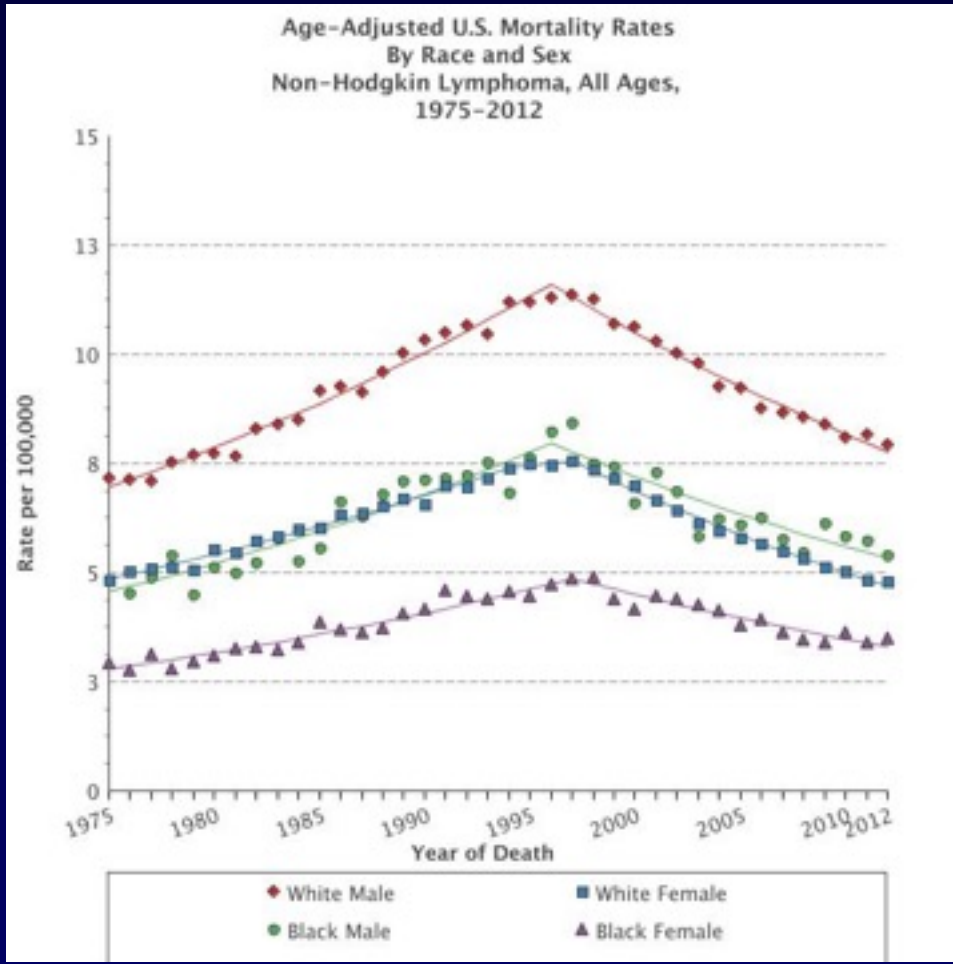


Non Hodgkin Lymphoma, by Race & Sex

Incidence



Mortality



Risk Factors

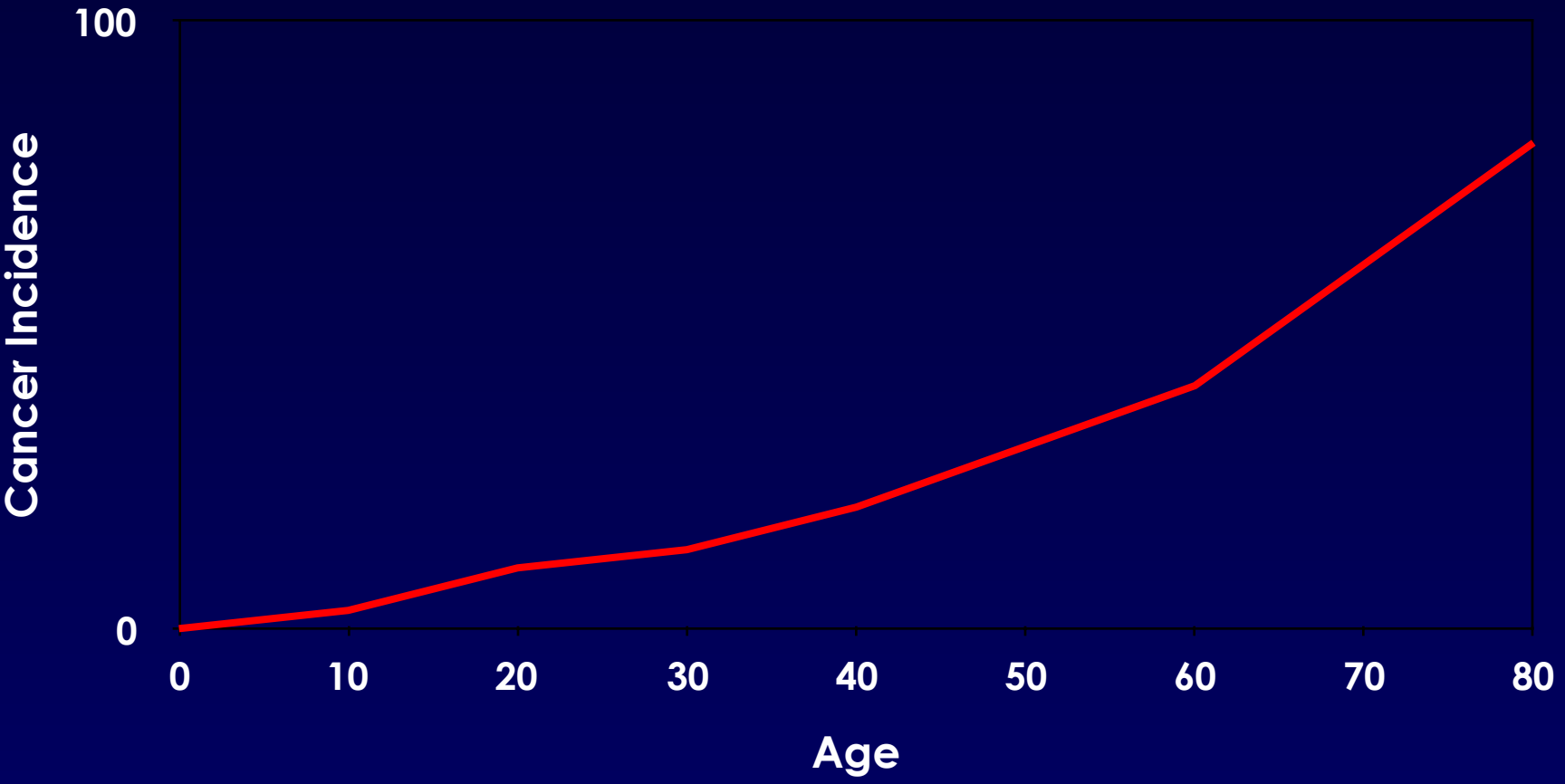
Un-modifiable

Age and Disease

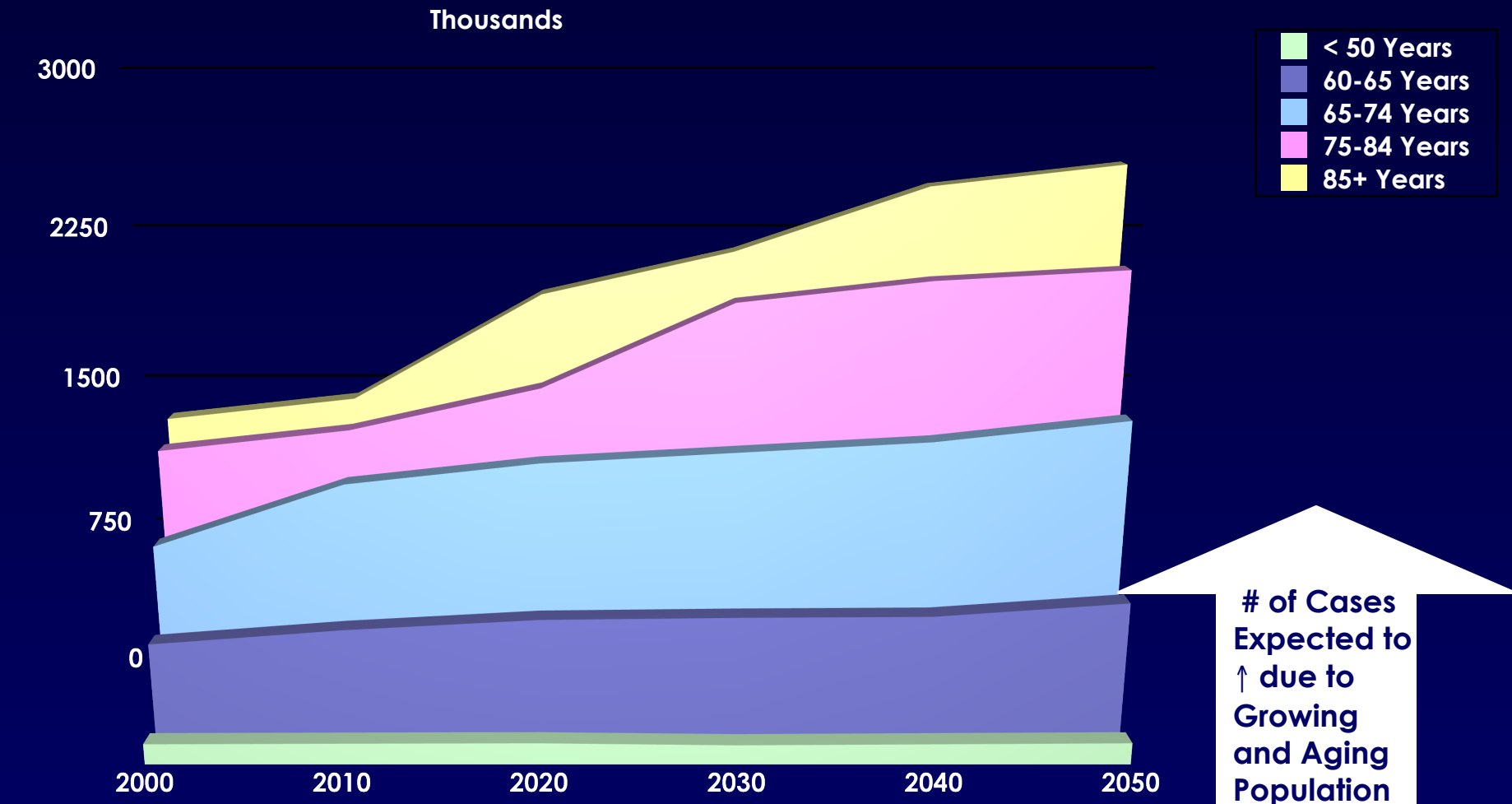
- # 1 risk factor for most diseases, including cancer

  – chronic exposure to etiologic agent
  – exposure to multiple etiologic agents
  – latent period
  – decreased immune function
  – increased comorbidity

Age and Cancer Incidence



Projections of Cancer Cases between 2000 and 2050



Source: SEER program, NCI and US Census Bureau

Risk Factors – Un-modifiable

- Family history of cancer
- Reproductive factors
- Physical / ethnic characteristics
- Residential or occupational characteristics

Risk Factors – Un-modifiable

- Family history of cancer
  - Colon cancer
    - Adenomous polyposis coli (APC), hereditary non-polyposis colon cancer (HNPCC)
  - Breast cancer
    - BRCA1, BRCA2, ATM
  - Ovarian cancer
    - BRCA1, BRCA2
  - Prostate Cancer

Risk Factors – Un-modifiable

- **Reproductive factors**
  - **Breast cancer**
    - **Age at menarche, age at menopause, age at first birth, parity, breastfeeding**
  - **Ovarian cancer**
    - **Parity, breast feeding**
  - **Endometrial cancer**
    - **Age at menopause, infertility, breast feeding**

Risk Factors – Un-modifiable

- Physical / ethnic characteristics
  - Melanoma
    - Skin type, eye color
  - Breast and ovarian cancer
    - Ashkenazi Jewish ethnicity
  - Prostate cancer
    - African-American ethnicity

Risk Factors – Un-modifiable

- Residential or occupational characteristics
  - Leukemia, thyroid cancer, breast cancer, lung cancer
    - Radiation exposure
  - Bladder cancer
    - Dye workers (Benzidine)
  - Lung cancer
    - Asbestos workers
  - Liver cancer
    - Vinyl chloride manufacture

Risk Factors

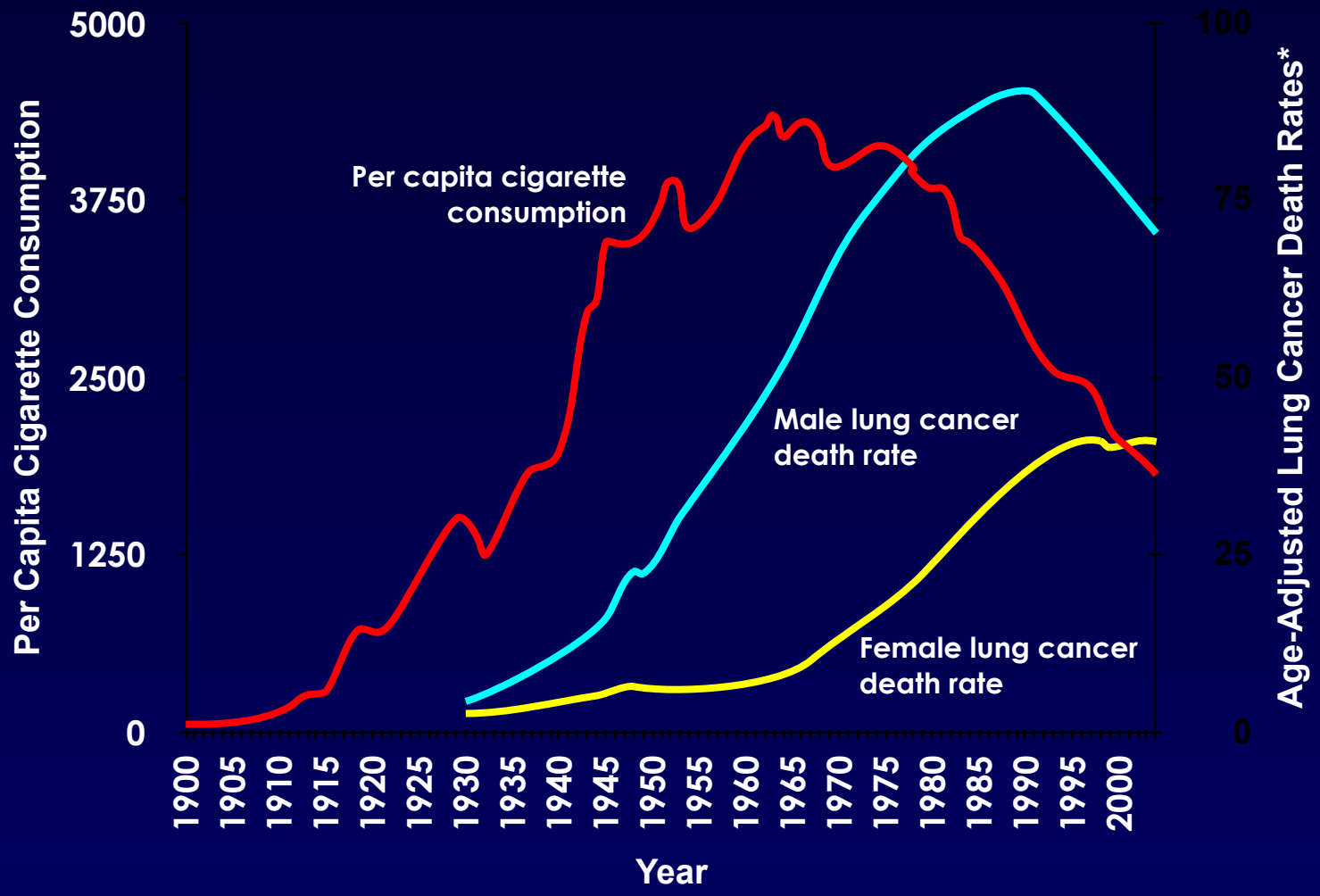
Modifiable

Tobacco Use

- Major preventable cause of disease and premature death in the US
- Increased risk for cancer of the lung, mouth, larynx, pharynx, esophagus, pancreas, kidney, bladder, and uterine cervix, colorectal and acute myeloid leukemia
- 30% of all cancer deaths and 87% of lung cancer deaths can be attributed to tobacco
- In 2014, tobacco use is responsible for 1 in 5 deaths or about 480,000 deaths per year
  - 159,260 of these from lung cancer

Source: American Cancer Society www.cancer.org Cancer Facts & Figures, 2014

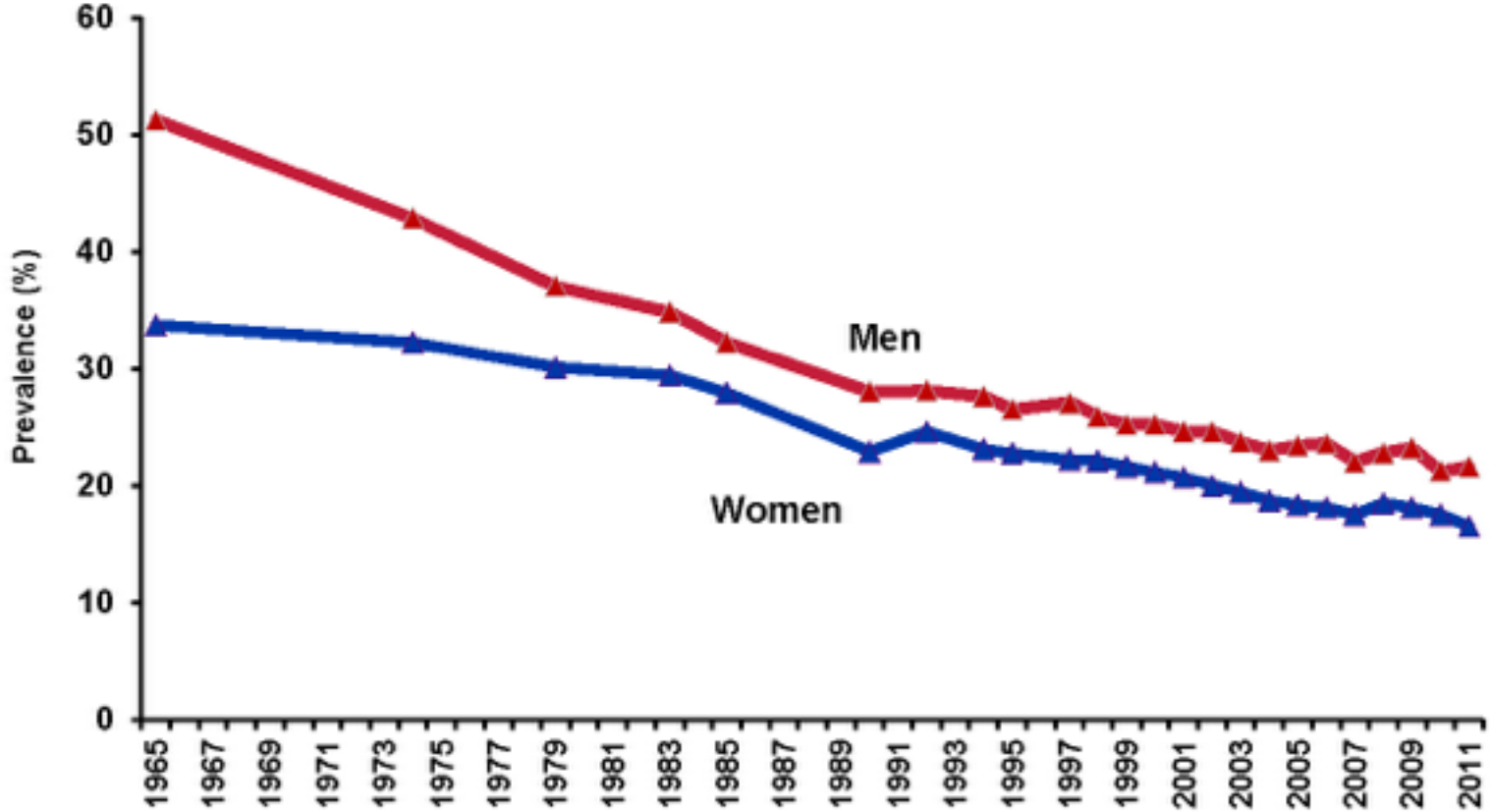
Tobacco Use in the US, 1900-2004



*Age-adjusted to 2000 US standard population.

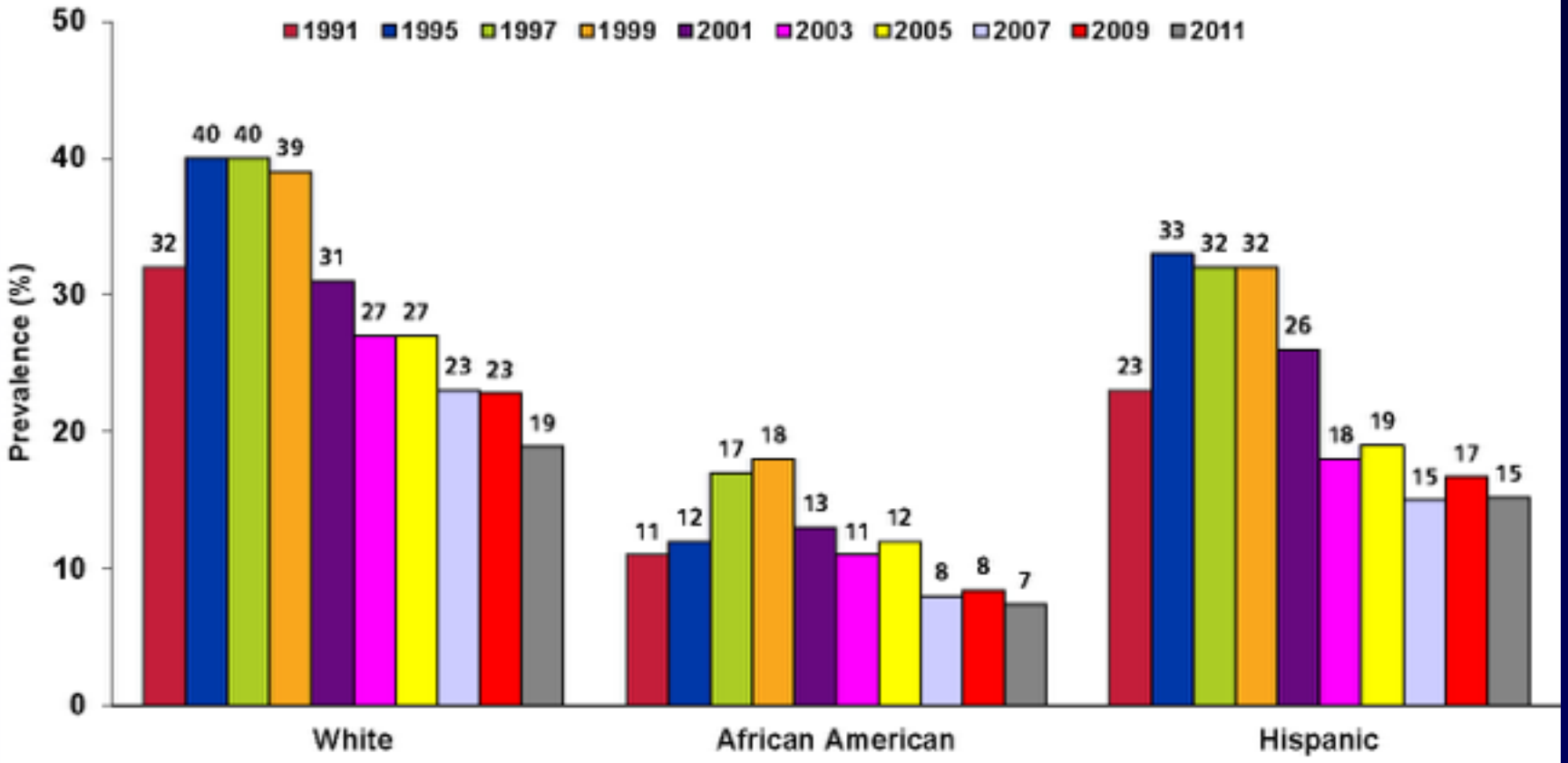
Source: Death rates: US Mortality Data, 1960-2004, US Mortality Volumes, 1930-1959, National Center for Health Statistics, Centers for Disease Control and Prevention, 2006. Cigarette consumption: US Department of Agriculture, 1900-2004.

Trends in Cigarette Smoking, Adults 18 and Older, US, 1965-2011



Redesign of survey in 1997 may affect trends. Estimates are age adjusted to the 2000 US standard population.
Source: National Health Interview Survey, National Center for Health Statistics, Centers for Disease Control and Prevention, 2012.

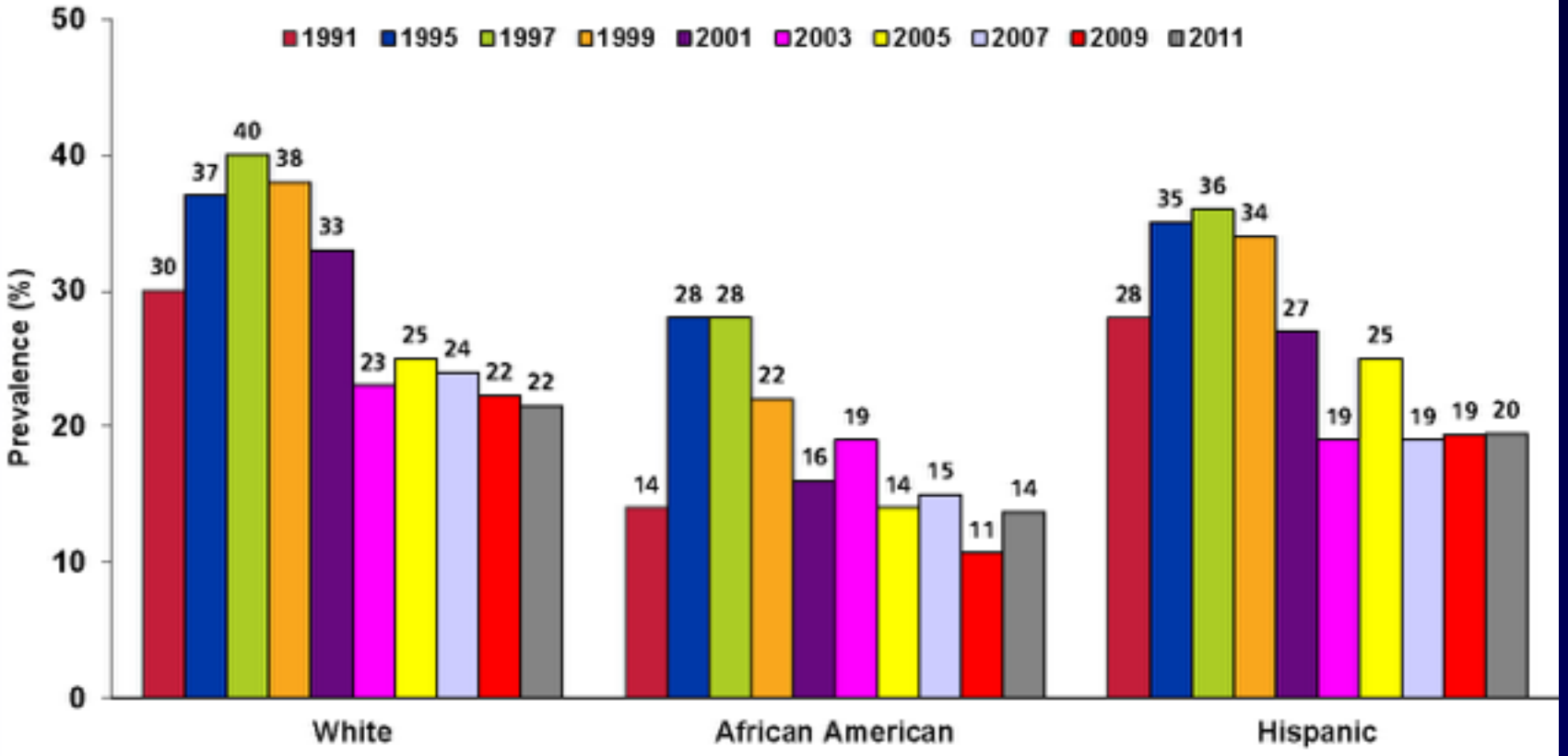
Trends in Cigarette Smoking* among Female High School Students, US, 1991-2011



*Smoked cigarettes on one or more of the 30 days preceding the survey. Whites and African Americans are non-Hispanic.

Source: Youth Risk Behavior Surveillance System, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, 2012.

Trends in Cigarette Smoking* among Male High School Students, US, 1991-2011



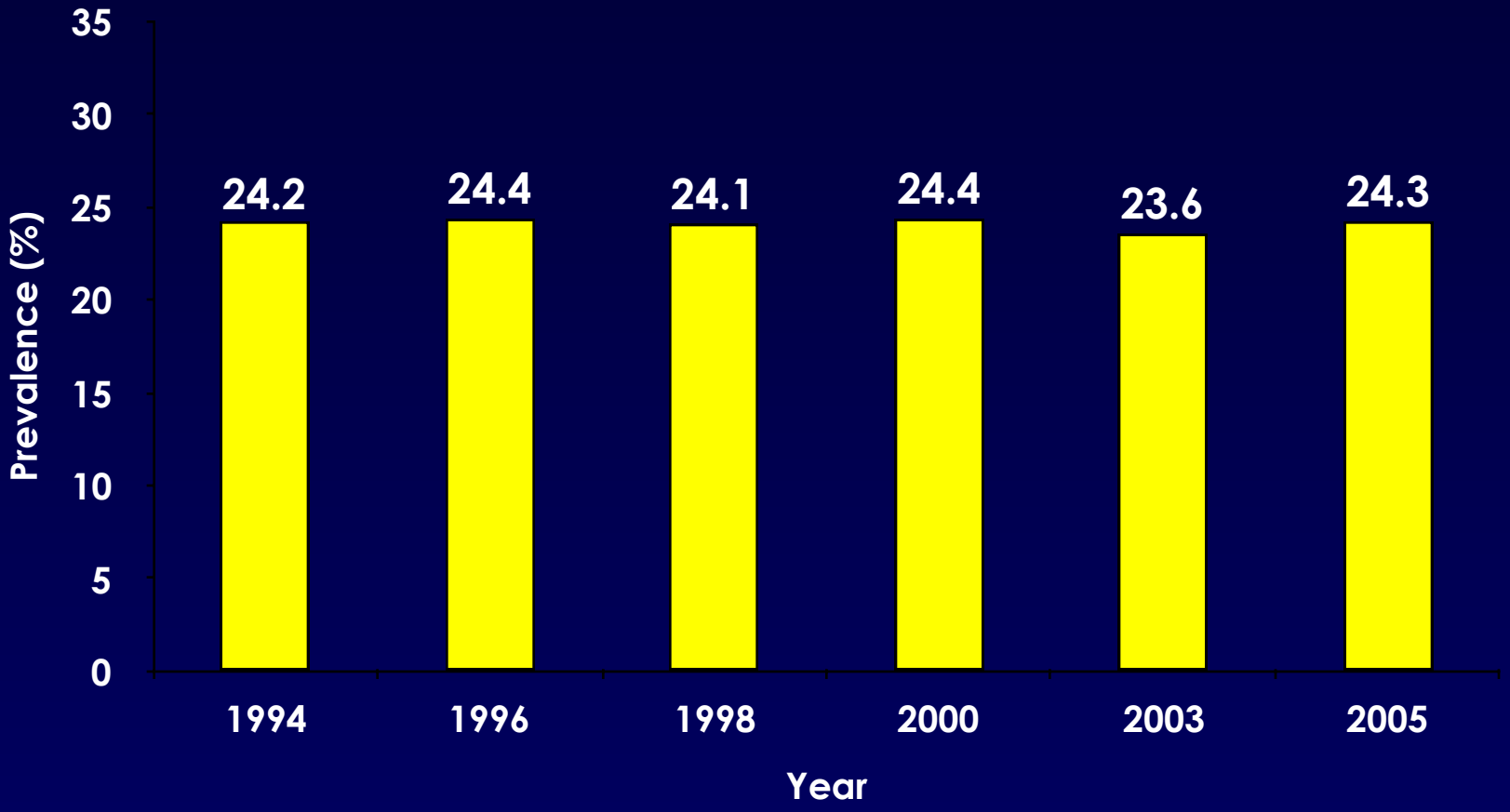
*Smoked cigarettes on one or more of the 30 days preceding the survey. Whites and African Americans are non-Hispanic.

Source: Youth Risk Behavior Surveillance System, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, 2012.

ACS Guidelines on Nutrition and Physical Activity for Cancer Prevention

- Eat a variety of healthful foods, with an emphasis on plant sources
  - Eat five or more servings of vegetables and fruit each day
  - Choose whole grains in preference to processed (refined) grains and sugars
  - Limit consumption of red meats, especially high-fat and processed meats
  - Choose foods that help maintain a healthful weight

Trends in Consumption of Five or More Recommended Vegetable and Fruit Servings for Cancer Prevention, Adults ≥18, US, 1994-2005



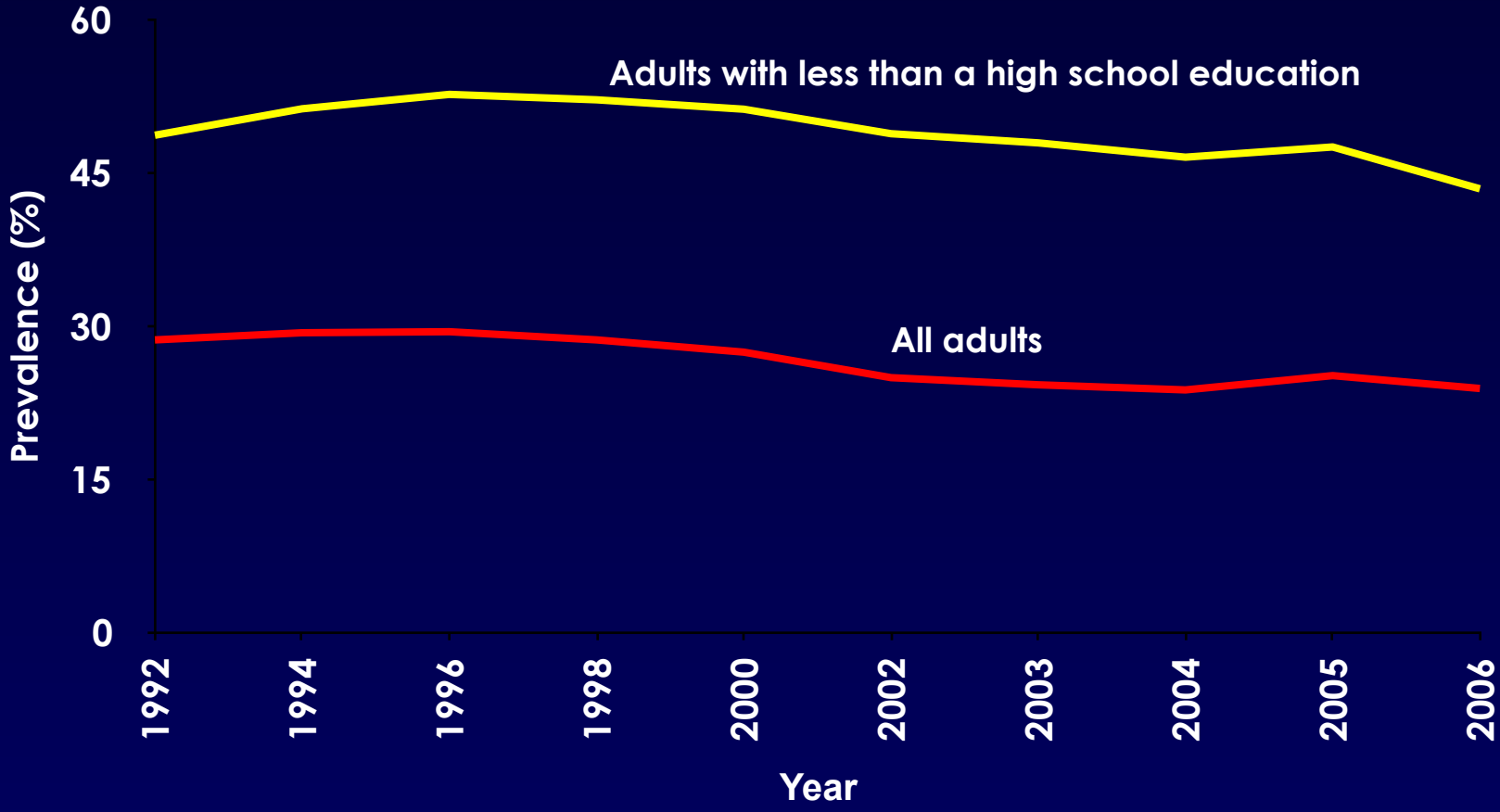
Note: Data from participating states and the District of Columbia were aggregated to represent the United States.

Source: Behavioral Risk Factor Surveillance System CD-ROM (1984-1995, 1996, 1998) and Public Use Data Tape (2000, 2003, 2005), National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, 1997, 1999, 2000, 2001, 2004, 2006.

ACS Guidelines on Nutrition and Physical Activity for Cancer Prevention

- Adopt a physically active lifestyle
  - Engage in at least moderate activity for 30 minutes or more on 5 or more days of the week
  - 45 minutes or more of moderate to vigorous activity on 5 or more days per week may further enhance reductions in the risk of breast and colon cancer

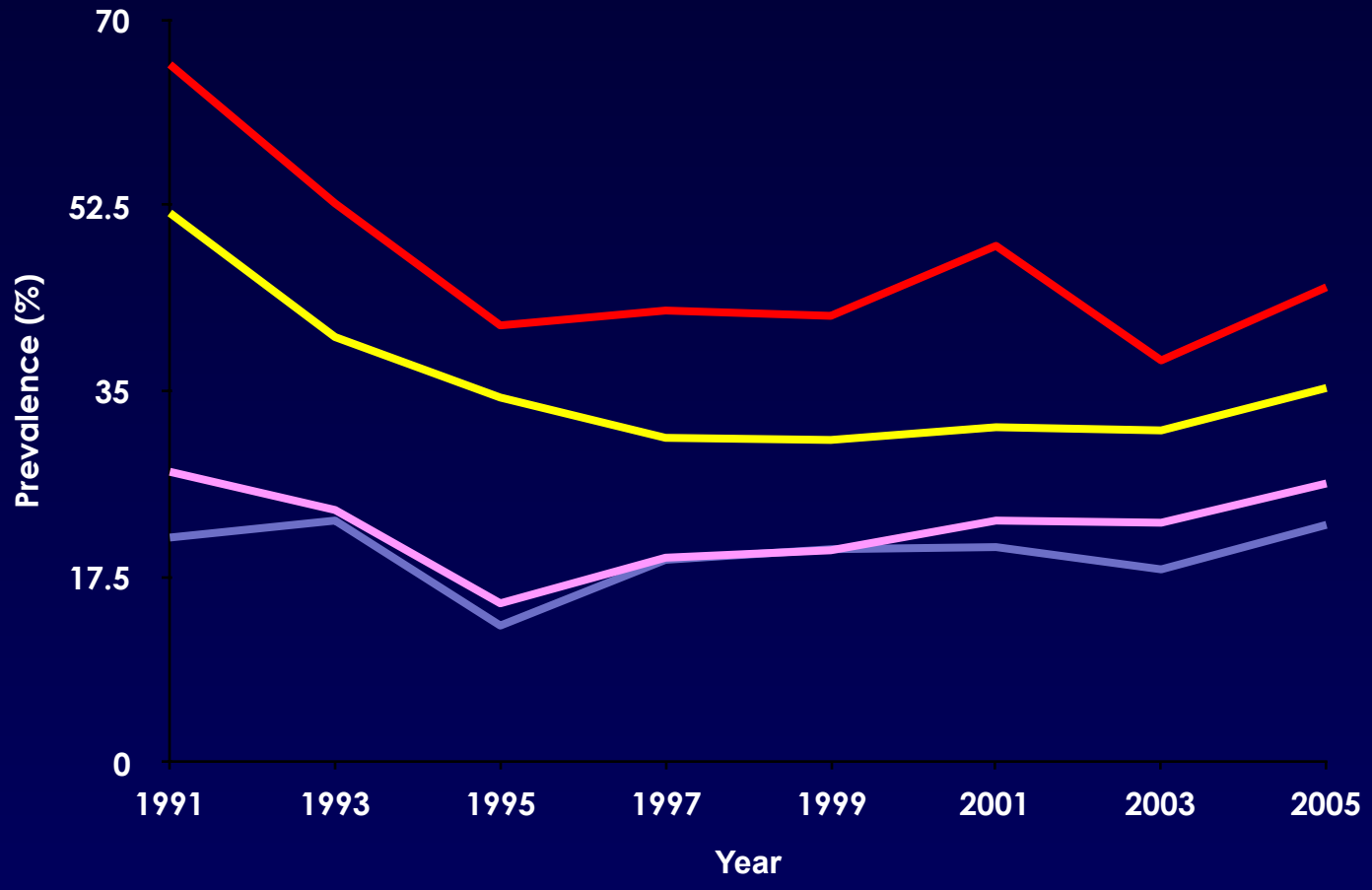
Trends in Prevalence (%) of No Leisure-Time Physical Activity, by Educational Attainment, Adults ≥18, US, 1992-2006



Note: Data from participating states and the District of Columbia were aggregated to represent the United States. Educational attainment is for adults 25 and older.

Source: Behavioral Risk Factor Surveillance System CD-ROM (1984-1995, 1996, 1998) and Public Use Data Tape (2000, 2002, 2004, 2005, 2006), National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, 1997, 1999, 2000, 2001, 2003, 2005, 2006, 2007.

Trends in Prevalence (%) of High School Students Attending PE Class Daily, by Grade, US, 1991-2005



Source: Youth Risk Behavior Surveillance System, 1991-2003, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, 2004. MMWR 2004;53(36):844-847. 2005: Youth Risk Behavior Surveillance System, 2005. MMWR Morb Mortal Wkly Rep. 2006;55(SS-5).

ACS Guidelines on Nutrition and Physical Activity for Cancer Prevention

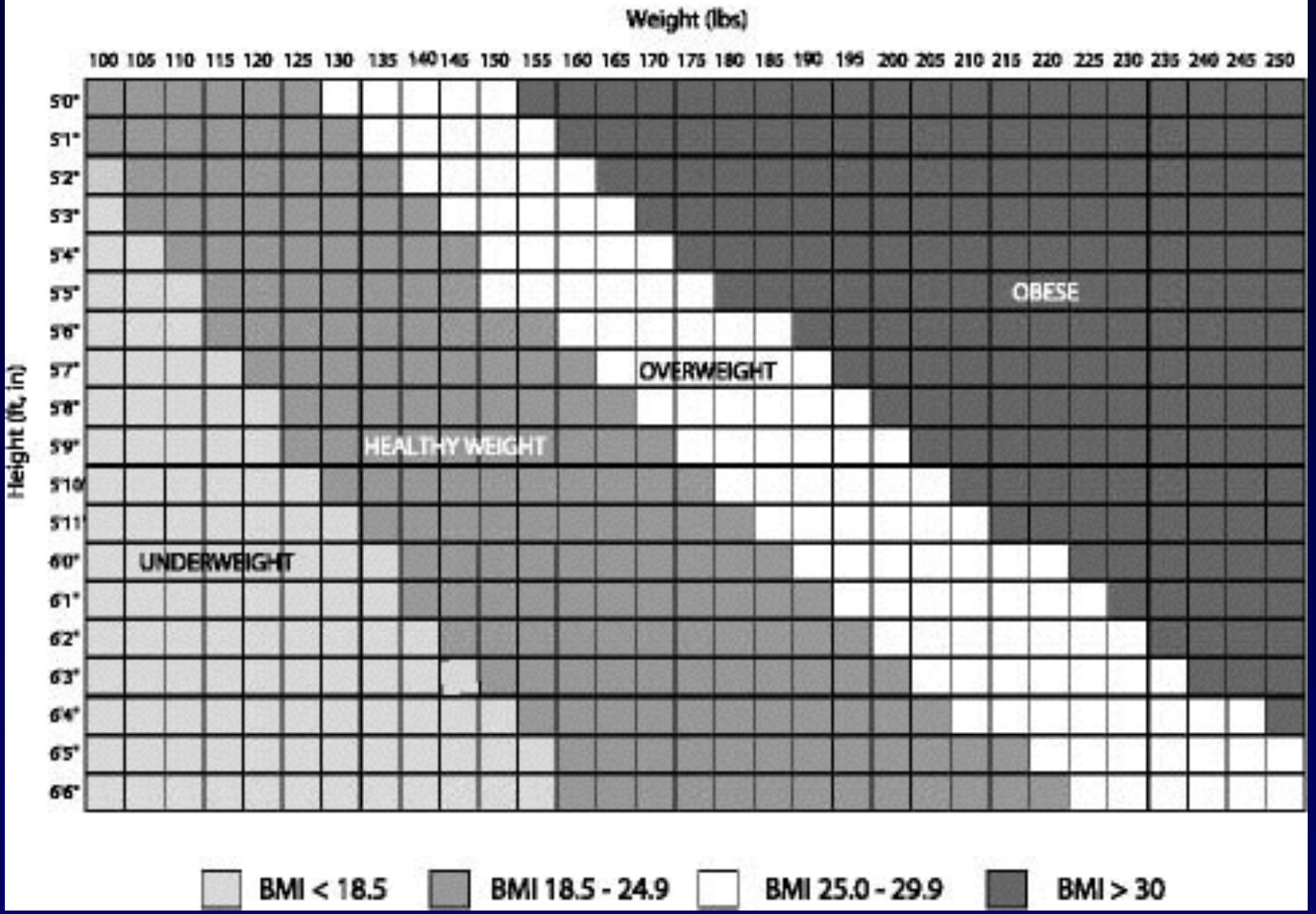
- Maintain a healthful weight throughout life
  - Balance caloric intake with physical activity
  - Lose weight if currently overweight or obese

Obesity Definition

Underweight	BMI <18.5
Normal weight	BMI 18.5 - 24.9
Overweight	BMI 25.0 – 29.9
Obese class I	BMI 30.0 – 34.9
Obese class II	BMI 35.0 – 39.9
Obese class III	BMI >40

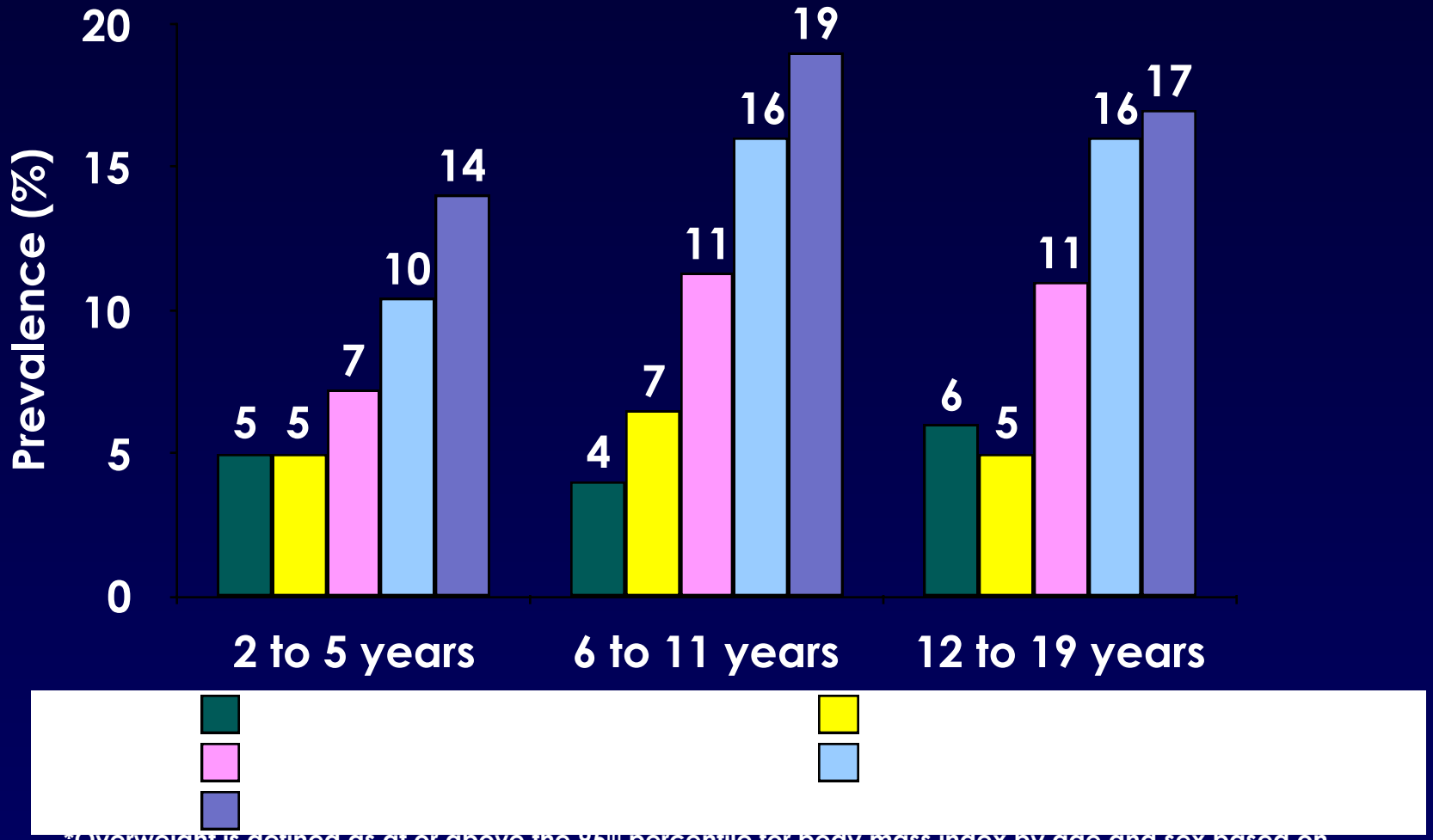
Adapted from: WHO (2000) Obesity: Preventing and Managing the Global Epidemic: Report of a WHO Consultation on Obesity

Body Mass Index Chart, Adults 20 and Over



Obesity Trends

Trends in Overweight* Prevalence (%), Children and Adolescents, by Age Group, US, 1971-2004



*Overweight is defined as at or above the 95th percentile for body mass index by age and sex based on reference data.

Source: National Health and Nutrition Examination Survey, 1971-1974, 1976-1980, 1988-1994, 1999-2002, National Center for Health Statistics, Centers for Disease Control and Prevention, 2002, 2004. 2003-2004: Ogden CL, et al. Prevalence of Overweight and Obesity in the United States, 1999-2004. JAMA 2006; 295 (13): 1549-55.

Secular Changes in Environment

- Food eaten outside of home
- Food availability
- Portion size shifts
- Food marketing
- Transportation
- Neighborhood safety
- City planning
- TV, video, computer work
- Economy and employment shifts

Health Consequences

- **Overweight & Obesity is associated with:**
  - Heart disease & cerebrovascular accidents
  - Type 2 Diabetes
  - Gallstones or gallbladder disease
  - Osteoarthritis
  - Gout
  - Sleep apnea
  - Hypertension
  - Hyperlipidemia
  - Pregnancy complications
  - Irregular menses

JADA 104(6): 984-1001, 2004

The NEW ENGLAND JOURNAL of MEDICINE

Overweight, Obesity, and Mortality from Cancer in a Prospectively Studied Cohort of U.S. Adults

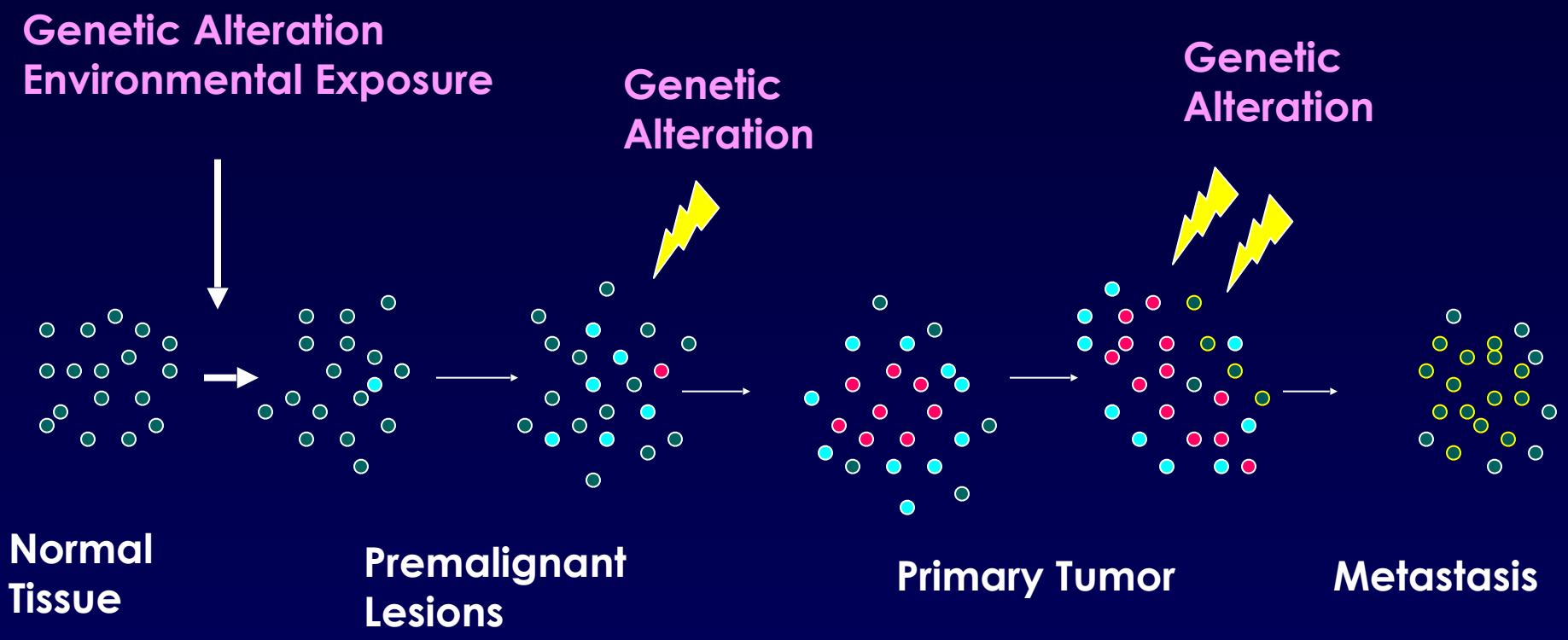
Eugenia E. Calle, Ph.D., Carmen Rodriguez, M.D., M.P.H., Kimberly Walker-Thurmond, B.A., and Michael J. Thun, M.D.

Body-mass index associated with higher rates of death due to cancer of the esophagus, colon and rectum, liver, gallbladder, pancreas, and kidney, non-Hodgkin's lymphoma, multiple myeloma, stomach, prostate, breast, uterus, cervix, and ovary.

Current patterns of overweight/obesity in the US could account for 14% of all deaths from cancer in men and 20% of those in women.

Screening

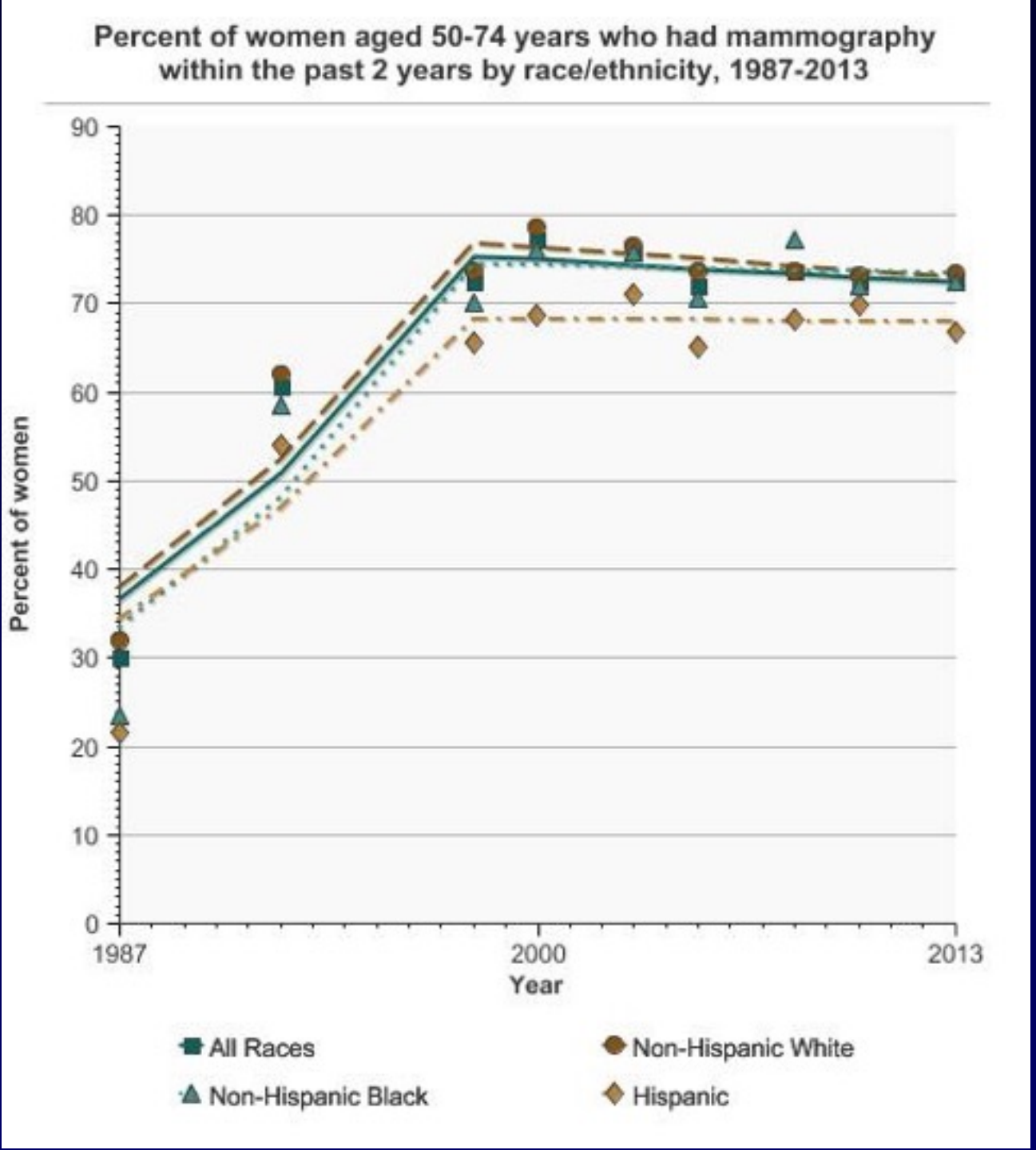
Malignant Progression of Human Cancer



Screening Guidelines for the Early Detection of Breast Cancer

- Yearly mammograms are starting at age 40
- Clinical breast exam every 3 years for women in their 20s and 30s, and every year for women 40 and older
- Breast self-exam is an option for women starting in their 20s
- Screening MRI is recommended for women with an approximately 20%-25% or greater lifetime risk of breast cancer, including women with a strong family history of breast or ovarian cancer and women treated for Hodgkin Lymphoma

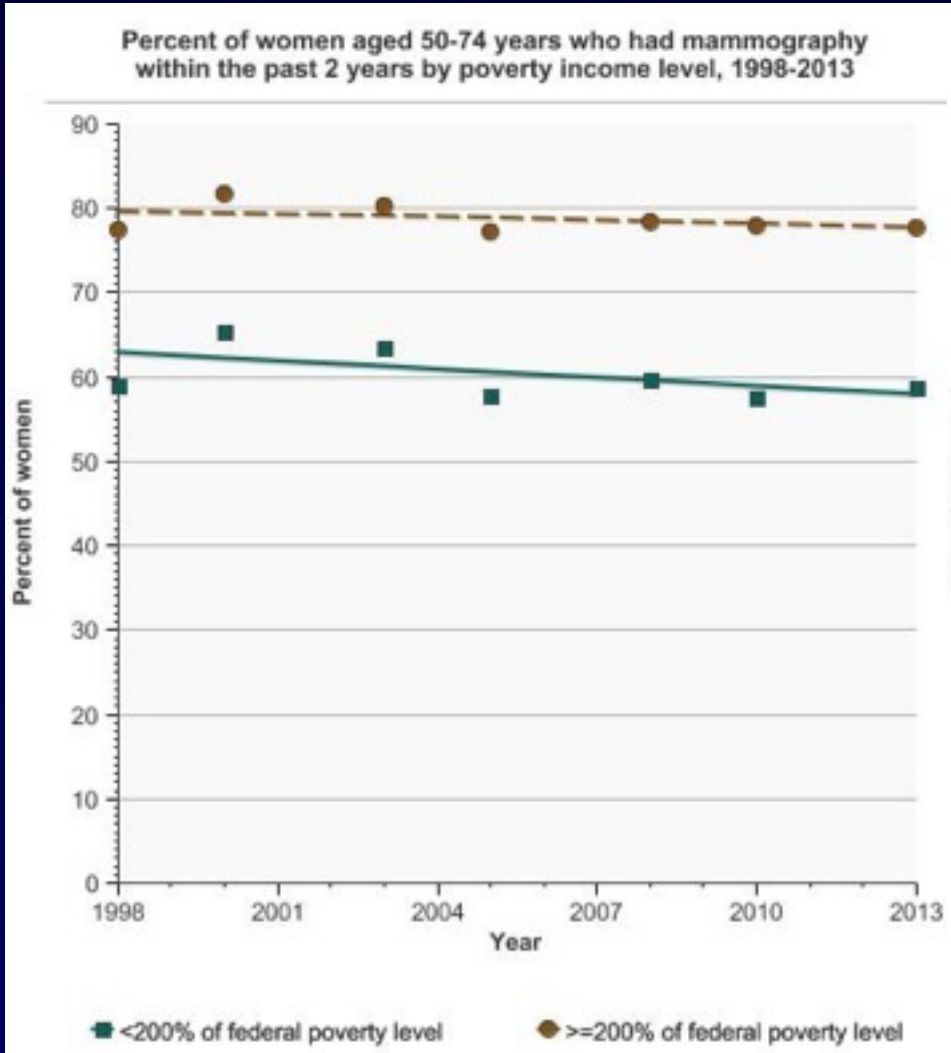
Source: American Cancer Society, www.cancer.org

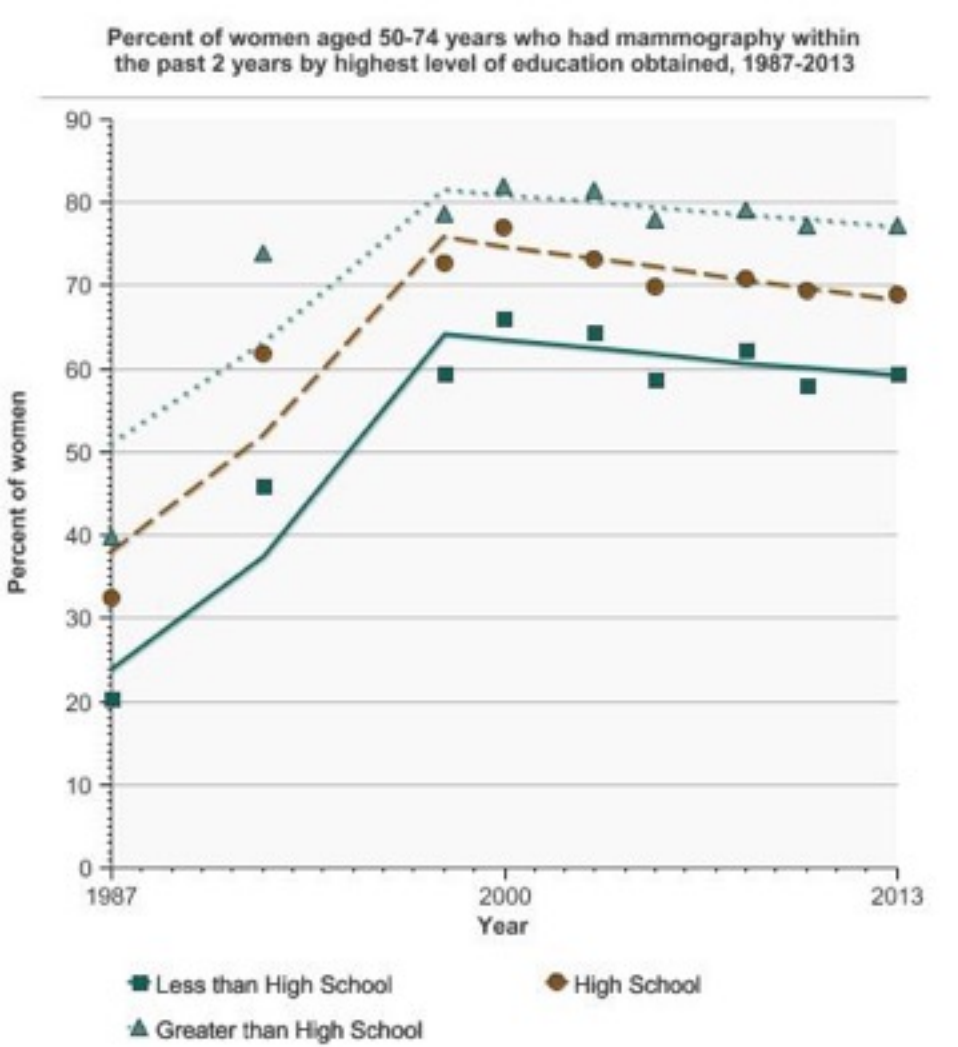


http://progressreport.cancer.gov/sites/default/files/graphs/

Income

Education





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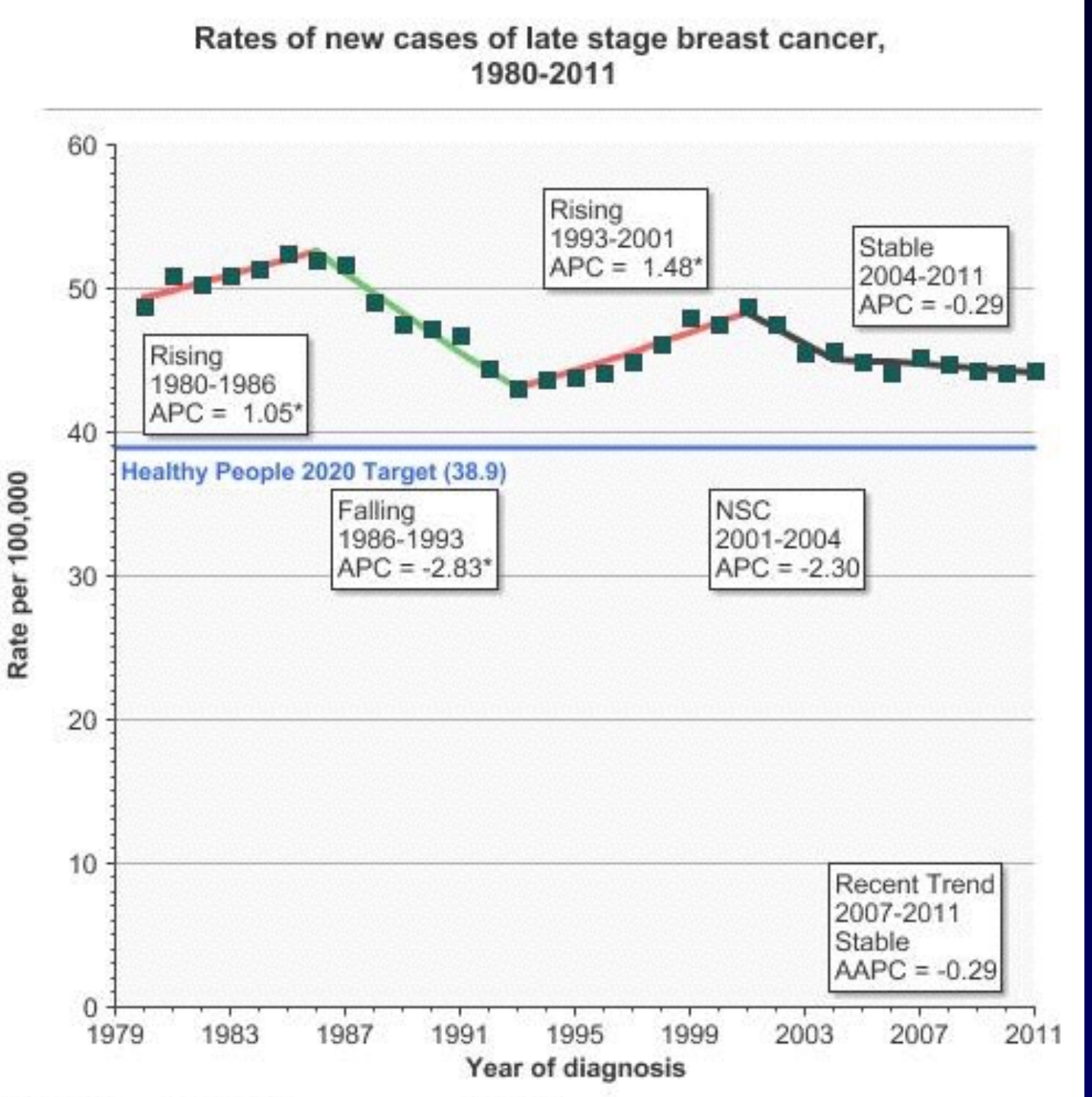


http://progressreport.cancer.gov/sites/default/files/graphs/

Screening Guidelines for Early Detection of Colorectal Cancer & Adenomas

Beginning at age 50, men and women should follow one of the following examination schedules:

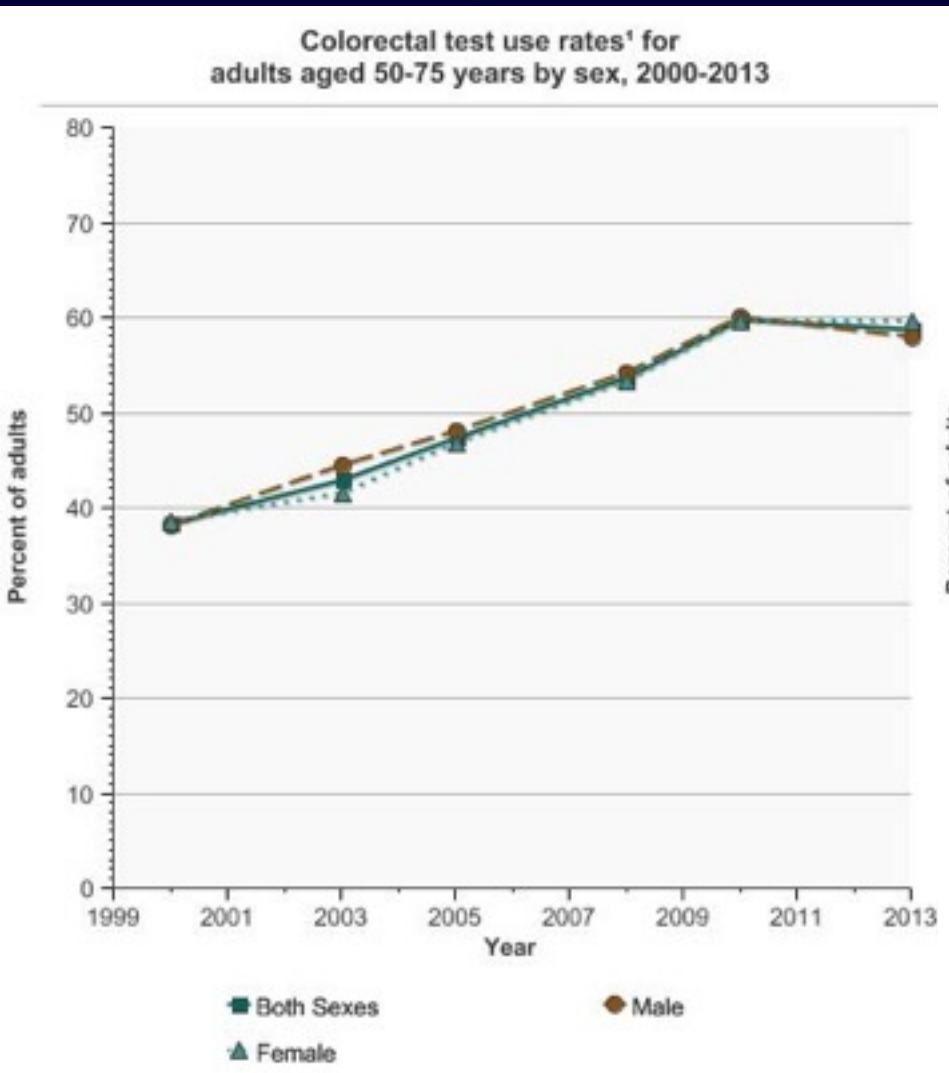
- Flexible sigmoidoscopy (FSIG) every five years
- Colonoscopy every ten years
- Double-contrast barium enema every five years
- CT colonography every five years
- Fecal occult blood test (FOBT) or a fecal immunochemical test (FIT) every year
- Stool DNA test (interval uncertain)

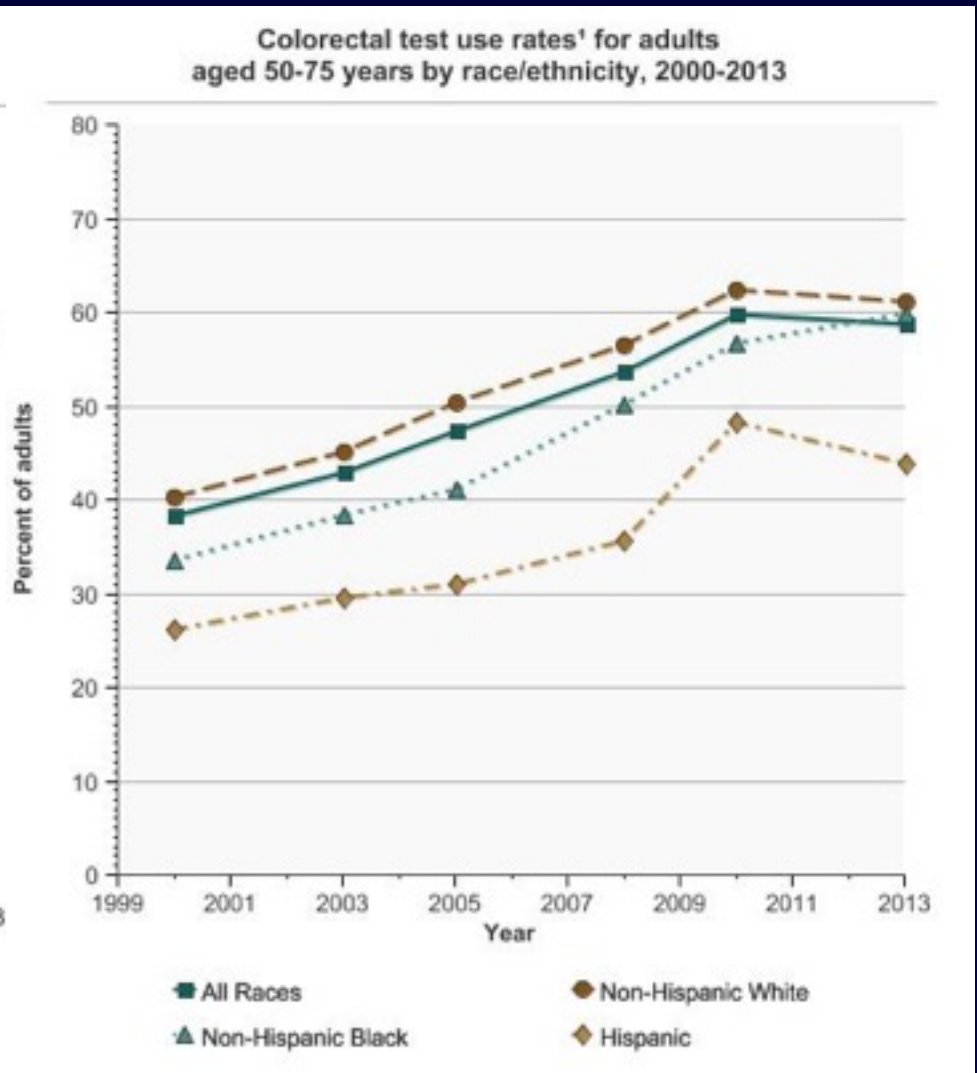
People who are at moderate or high risk for colorectal cancer should talk with a doctor about a different testing schedule

Source: American Cancer Society, www.cancer.org

Gender

Race





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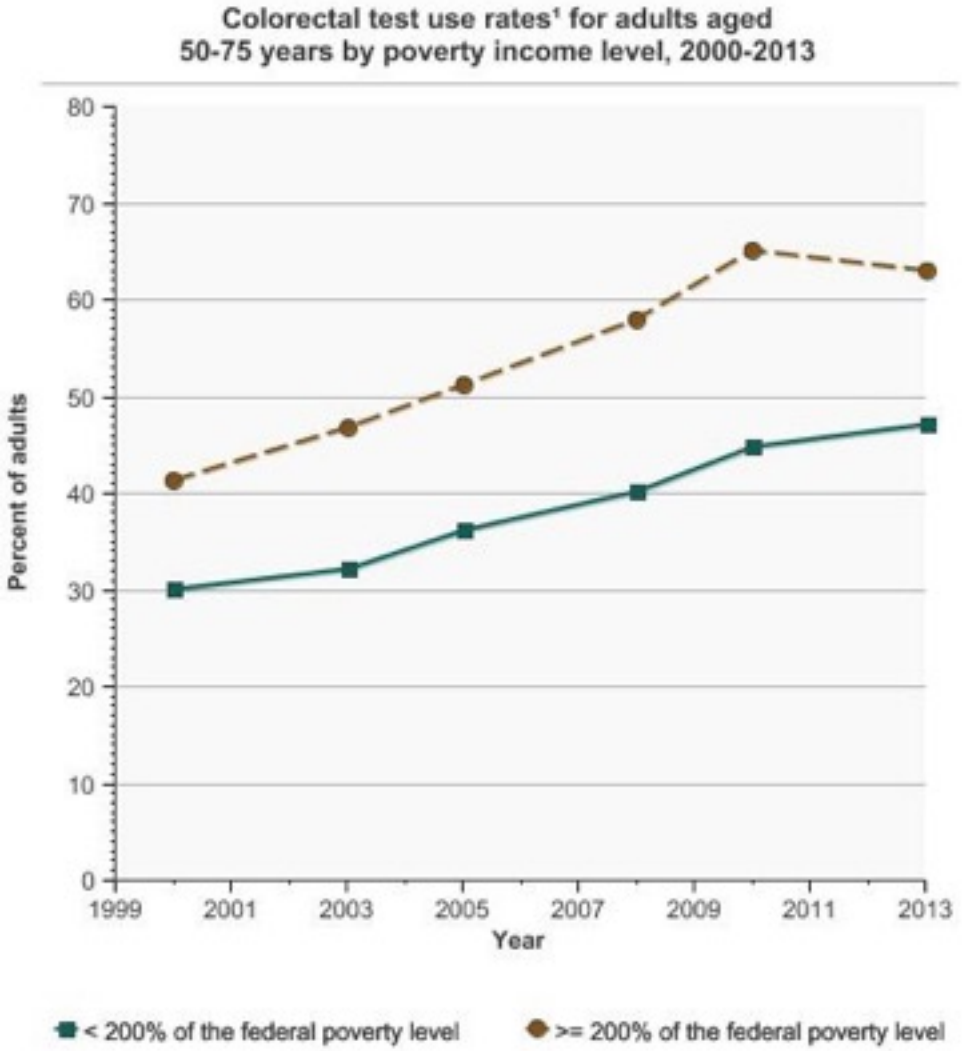
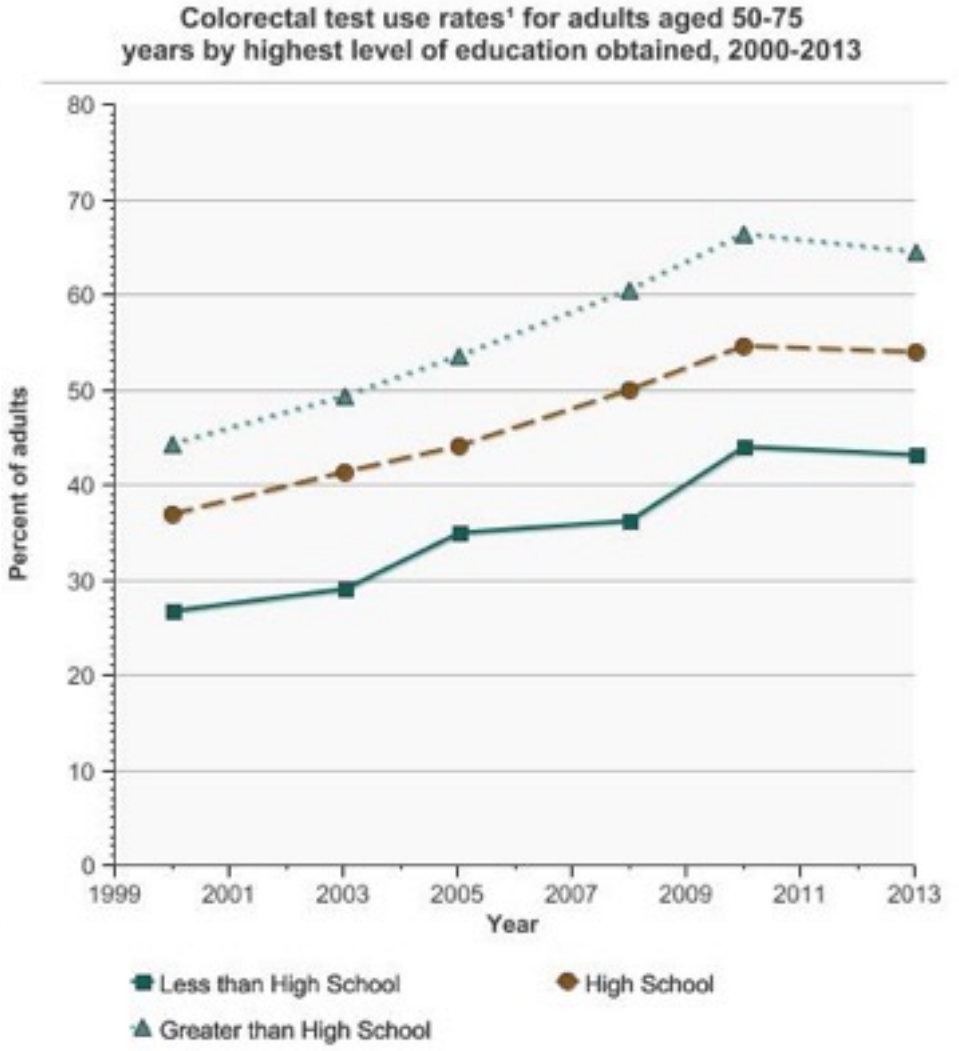
Income



Education



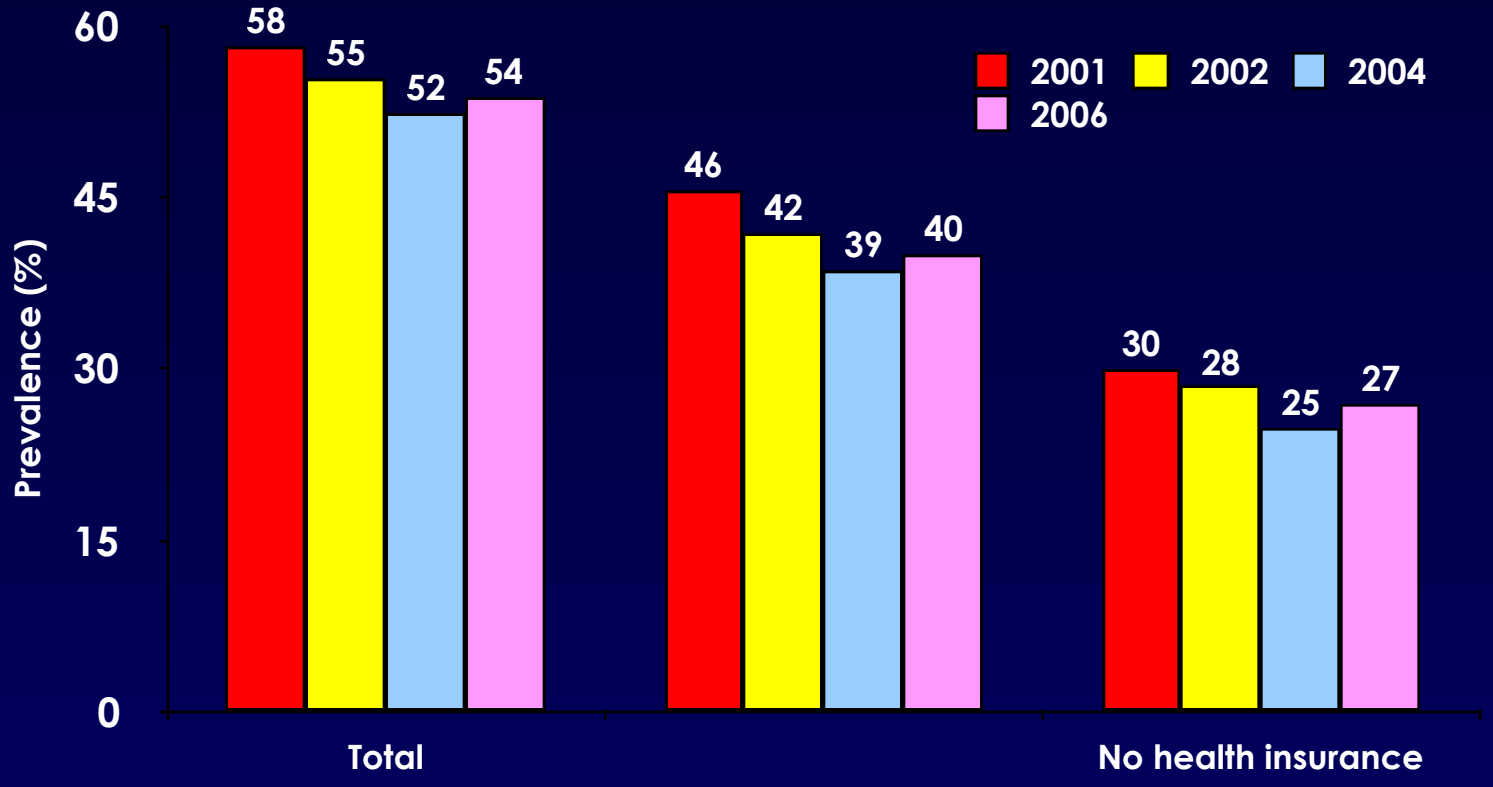
http://progressreport.cancer.gov/sites/default/files/graphs/

Screening Guidelines for Early Detection of Prostate Cancer

- Prostate-specific antigen (PSA) test and digital rectal examination (DRE) should be offered annually, beginning at age 50, to men who have a life expectancy of at least 10 years
- Men at high risk (African-American men and men with a strong family history) should begin testing at age 45
- For men at average risk and high risk, information should be provided about what is known and what is uncertain about the benefits and limitations of early detection and treatment of prostate cancer so that they can make an informed decision about testing

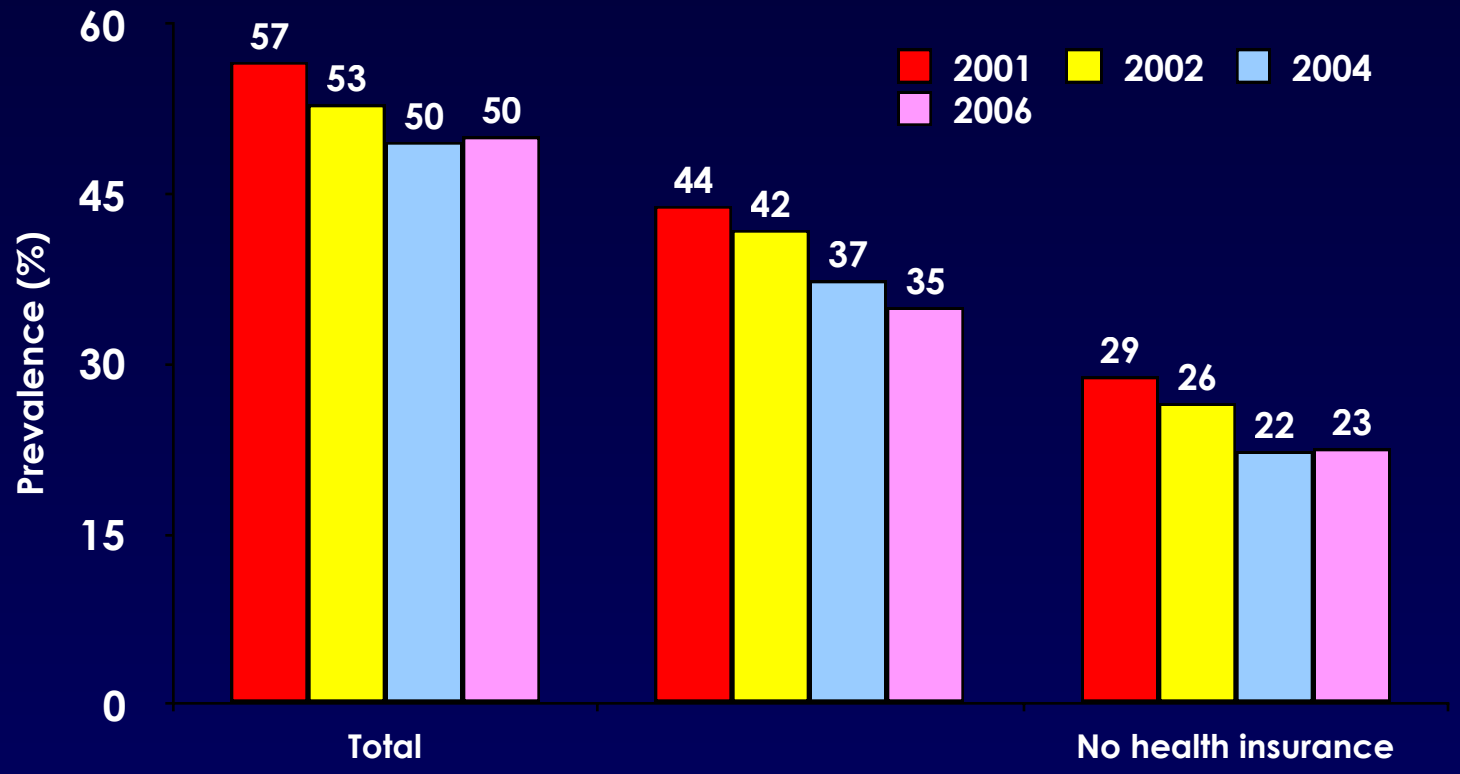
Source: American Cancer Society, www.cancer.org

Recent* Prostate-Specific Antigen (PSA) Test Prevalence (%), by Educational Attainment and Health Insurance Status, Men 50 Years and Older, US, 2001-2006



*A prostate-specific antigen (PSA) test within the past year. Note: Data from participating states and the District of Columbia were aggregated to represent the United States.
Source: Behavioral Risk Factor Surveillance System Public Use Data Tape (2001, 2002, 2004, 2006), National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, 2002, 2003, 2005, 2007.

Recent* Digital Rectal Examination (DRE) Prevalence (%), by Educational Attainment and Health Insurance Status, Men 50 Years and Older, US, 2001-2006



*A digital rectal examination (DRE) within the past year. Note: Data from participating states and the District of Columbia were aggregated to represent the United States.

Source: Behavioral Risk Factor Surveillance System Public Use Data Tape (2001, 2002, 2004, 2006), National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, 2002, 2003, 2005, 2007.

Questions?

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