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# The Annual Report to the Nation on the Status of Cancer, 1973–1997, with a Special Section on Colorectal Cancer

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COMMUNICATION

# The Annual Report to the Nation on the Status of Cancer, 1973–1997, with a Special Section on Colorectal Cancer

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**BACKGROUND.** This annual report to the nation addresses progress in cancer prevention and control in the U.S. with a special section on colorectal cancer. This report is the joint effort of the American Cancer Society, the National Cancer Institute (NCI), the North American Association of Central Cancer Registries (NAACCR), and the Centers for Disease Control and Prevention (CDC), including the National Center for Health Statistics (NCHS).

**METHODS.** Age-adjusted rates were based on cancer incidence data from the NCI and NAACCR and underlying cause of death as compiled by NCHS. Joinpoint analysis was based on NCI Surveillance, Epidemiology, and End Results (SEER) program incidence rates and NCHS death rates for 1973–1997. The prevalence of screening examinations for colorectal cancer was obtained from the CDC's Behavioral Risk Factor Surveillance System and the NCHS's National Health Interview Survey.

**RESULTS.** Between 1990–1997, overall cancer incidence and death rates declined. Joinpoint analyses of cancer incidence and death rates confirmed the declines described in earlier reports. The incidence trends for colorectal cancer have shown recent steep declines for whites in contrast to a leveling off of the rates for blacks. State-to-state variations occurred in colorectal cancer screening prevalence as well as incidence and death rates.

**CONCLUSIONS.** The continuing declines in overall cancer incidence and death rates

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are encouraging. However, a few of the top ten incidence or mortality cancer sites continued to increase or remained level. For many cancer sites, whites had lower incidence and mortality rates than blacks but higher rates than Hispanics, Asian and Pacific Islanders, and American Indians/Alaska Natives. The variations in colorectal cancer incidence and death rates by race/ethnicity, gender, age, and geographic area may be related to differences in risk factors, demographic characteristics, screening, and medical practice. New efforts currently are underway to increase awareness of screening benefits and treatment for colorectal cancer. ***Cancer* 2000;88:2398–424.** 

**KEYWORDS: neoplasm, incidence rate, mortality, race, surveillance, colon, rectum, joinpoint, screening.**

On the 25th anniversary of the National Cancer Act in 1996, the American Cancer Society (ACS), the National Cancer Institute (NCI), and the Centers for Disease Control and Prevention (CDC), which includes the National Center for Health Statistics (NCHS), reported the first sustained decline in cancer death rates since national recordkeeping was instituted in the 1930s.[1-5] For this third annual report, these organizations, along with the North American Association of Central Cancer Registries (NAACCR), are collaborating to monitor cancer statistics and to describe progress related to cancer prevention and control in the U.S.[4,6] This report updates and confirms the continuing declines in cancer incidence and death rates in the U.S. and provides cancer incidence and death rates in five populations: whites, blacks, American Indians/Alaska Natives (AI/AN), Asian/Pacific Islanders (API), and Hispanics for 1990–1997. Finally, this report uses a new statistical methodology, joinpoint analysis, to describe long term trends and includes a special section on the occurrence of colorectal cancer and screening.

## MATERIALS AND METHODS

All statistics presented in this report plus additional data on cancer rates of incidence, mortality, survival, and screening are available from the following URL: www.seer.cancer.gov.

### Cancer Cases

Information regarding newly diagnosed cancer cases occurring in the U.S. from 1973 to 1997 is based on data collected by the NCI's Surveillance, Epidemiology, and End Results (SEER) program.[5] Briefly, the SEER program collects cancer incidence data from 11 population-based registries, including five states (Connecticut, Hawaii, Iowa, New Mexico, and Utah) and six standard metropolitan statistical areas (Atlanta, Detroit, Los Angeles, San Francisco-Oakland, San Jose-Monterey, and Seattle-Puget Sound). In addition, cancer incidence data for Alaska Natives from Alaska are included with the rates for AI/ANs for 1990–1997. Estimates of rates and trends in cancer incidence rates for the U.S. frequently are based on SEER data. For the trend analyses, SEER cancer incidence data for 1973–1997 are from nine geographic areas covering approximately 10% of U.S. population and data for 1990–1997 are from 11 geographic areas covering 14% of the U.S. population. The race/ethnicity-specific incidence rates for 1990–1997 also are based on data covering 14% of the U.S. population.[5]

For the first time, colorectal cancer data from selected population-based cancer registries participating in the NAACCR annual call–for-data are included. Colorectal cancer incidence rates for 1993–1997 are from states selected according to whether they meet the criteria established by the NAACCR for highest quality pooled data for this time period.[7,8] Of the 40 states and 10 SEER registries submitting data, 28 met all the criteria. Furthermore, 23 of these registries exceeded 95% completeness for case ascertainment. Approximately 49% of the U.S. population is included in the NAACCR combined colorectal cancer incidence rate.

All information regarding primary tumor site and histology for incidence was converted to the second edition of the International Classification of Diseases for Oncology (ICDO-2).[9] The site groupings included in this report have been published previously.[5]

### Cancer Deaths

Information regarding cancer deaths in the U.S. is based on causes of death reported by the certifying physicians on death certificates filed in state vital statistics offices. The mortality information is processed and consolidated into a national database by NCHS (reference 10 and unpublished data).[10] The underlying cause of death is selected for tabulation following the procedures specified by the World Health Organization in the current Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death (ICD). For the period 1950–1957, the sixth revision (ICD-6) was used[11]; for 1958–1967, the seventh

revision (ICD-7) was used[12]; for 1973–1978, the eighth revision (ICDA-8) was used[13]; and for 1979–1997 the ninth revision (ICD-9) was used.[14] Although the majority of long term trends presented in this report were between 1973–1997, trends in age specific death rates were examined from 1950–1997 separately for males and females. For comparability in rates between 1950–1997, deaths from cancer of the colon/rectum included deaths due to cancer of the anus and anal canal. To ensure comparability between the ICDA-8 and ICD-9 codes, ICDA-8 codes on individual records were converted to ICD-9 codes by applying a conversion algorithm used by the NCI, and the ICD-9 codes are categorized according to SEER site groups.[5]

### Cancer Incidence and Death Rates

Resident population estimates for each year from the U.S. Bureau of the Census (unpublished data) were used to compute age-adjusted cancer incidence and death rates; population data for whites were adjusted slightly for an overcount of whites in Hawaii (unpublished data). Because information regarding Hispanic origin is collected separately from race, persons categorized as Hispanic were not mutually exclusive from whites, blacks, AI/AN, and API.

Rates are expressed as per 100,000 population and are age-adjusted by the direct method to the 1970 U.S. standard million population. All rates in this report are based on at least 20 cases or deaths. Death rates are prepared by the NCI based on numbers of deaths from the Vital Statistics System of the NCHS and population estimates as described earlier. For cancer sites that pertain only to men or women, rates are based on gender-specific data. The term "all sites" refers to all cancer sites combined, not to the sum of the sites in the tables and figures. Specific abbreviations include lung to designate lung and bronchus, brain to designate brain and central nervous system, corpus uteri to designate corpus uteri and uterus not otherwise specified (NOS), NHL to designate non-Hodgkin lymphoma, and IBD to designate intrahepatic bile duct.

For cancer incidence rates, the denominators are county level population data for the geographic areas that participate in SEER and for the states that submitted data to the NAACCR. Cancer incidence rates for AI/AN are based on data from Alaska plus all SEER registries.

For cancer death rates, the denominators are county level population data summed across all of the counties and states for the total U.S., except for Hispanic data. Cancer death rates for Hispanics include cancer deaths and populations from all states except Connecticut, Louisiana, New Hampshire, and Oklahoma, which are omitted due to the absence of comparable data on Hispanic origin for all years. Cancer death rates for AI/AN include data from all states.

### Relative Survival Rates

The SEER relative survival rates include cases diagnosed in five states (Connecticut, Hawaii, Iowa, New Mexico, and Utah) and four metropolitan areas (Atlanta, Detroit, San Francisco-Oakland, and Seattle). Survival data were calculated by anatomic subsite of the colon/rectum and stage of disease at diagnosis, using the third edition of the American Joint Commission on Cancer (AJCC) TNM staging classification.[15]

### Annual Percent Change

The annual percent change (APC) is estimated by fitting a regression line to the natural logarithm of the rates using calendar year as a regressor variable (i.e., $y = m x + b$ in which $y = \ln$ [rate] and $x =$ calendar year). The estimated APC then is equal to $100 * (e^m - 1)$. Testing the hypothesis that the APC is equal to zero is equivalent to testing the hypothesis that the slope of the line in the above equation is equal to zero (i.e., that the rate is not increasing or decreasing). The hypothesis test statistic uses the t distribution of $m/SE_m$ in which SE is the standard error of m and the number of degrees of freedom is equal to the number of calendar years minus two.[16] The calculation assumes that rates increase or decrease at a constant rate over time although the validity of this assumption has not been assessed. Statistical significance is assessed using a two-sided $P$ value $= 0.05$.

### Joinpoint Analysis

Sometimes rates did not increase (decrease) the same amount over the entire time period from 1973–1997 (i.e., one straight line [on a log scale] does not fit the trend). Instead, for many sites, increases occurred in the early years followed by declines in more recent years. Joinpoint analysis is a statistical method that describes changing trends over successive segments of time and the amount of increase or decrease within each.[17] Joinpoint analysis chooses the best fitting point(s), called joinpoint(s), at which the rate of increase or decrease changes significantly. The analysis begins with an assumption of constant change in the rate over time (i.e., no joinpoint). Up to three joinpoints were tested in the model. Thus, in the final model each joinpoint denotes a significant change in trend, and each of those trends is described by an APC. Significant changes may include changes in direction or changes in the rate of increase (decrease). The rate of change is tested to determine whether it is different from zero (i.e., significantly increasing or decreasing). Lines are used to represent the predicted

trend and symbols to represent the observed rates in the joinpoint analyses. The results of the joinpoint analyses for the major cancer sites are summarized in Table 1 for incidence and Table 2 for deaths. The software to perform joinpoint analyses is available from the Surveillance Research Program of the NCI on the Worldwide Web at: http://www-dccps.ims.nci.nih.gov/SRAB/.

To simplify describing the joinpoint analysis, statistically significant increases or decreases over a particular segment of time are described as slight if they were under 1% per year, steady if they were between 1%–4%, and sharp if they were ≥ 4%. If the increase or decrease was not statistically significant, the trend was described as level. The term "more rapid" was used to describe increases (or decreases) that became more pronounced during the next time period.

### Colorectal Cancer Screening (National Health Interview Survey and Behavioral Risk Factor Surveillance System)

The prevalence of colorectal cancer screening is based on data collected through the National Health Interview Survey (NHIS) [18] and the Behavioral Risk Factor Surveillance System (BRFSS).[19] The NHIS is a continuing nationwide household survey that collects information from a representative sample of the U.S. civilian, noninstitutionalized population age ≥ 18 years.[18] The overall response rates for the 1987 and 1992 NHIS surveys were 95.3% (n = 122,859) and 95.7% (n = 128,412), respectively.[20] Data from the 1998 NHIS are preliminary estimates of prevalence published as baseline measures for Healthy People 2010.[21]

The BRFSS is an ongoing system of telephone surveys conducted by state health departments in cooperation with the CDC, and designed to collect risk factor information and monitor intervention efforts over time using a population-based, random-digit dialed telephone survey of the non-institutionalized U.S. population age ≥ 18 years. Some states employ geographic stratification to oversample specific racial/ethnic populations. Thus, all analyses are weighted according to the sampling design.

In 1997, all 50 states, the District of Columbia, and Puerto Rico participated in the BRFSS. A total of 52,754 persons age ≥ 50 years were asked whether they had ever had a blood stool test (also referred to as fecal occult blood test [FOBT]) using a home-administered kit and whether they had ever undergone a sigmoidoscopy or proctoscopy. If they had ever had the test, respondents also were asked when the last test was performed. Responses coded as "Don't know/Not sure" or "Refused" were excluded from the analysis (approximately 3%). State-level data were weighted to the age, gender, and racial/ethnic distribution of the state's adult population using 1990 census or intercensal estimates. Proportions, standard errors, and 95% confidence intervals were calculated using SAS and SUDAAN [22] to adjust for the sampling strategies. Percentages were suppressed when numerator or denominator counts were < 20. For the U.S. estimates, data were aggregated for all 50 states and the District of Columbia. Of note, BRFSS estimates presented in this report for the total U.S. do not agree exactly with previously published estimates [23] because total U.S. in this analysis did not include Puerto Rico. Aggregated and state-level data (including Puerto Rico) are presented for the proportion of respondents who reported undergoing FOBT or sigmoidoscopy/proctoscopy during the recommended time period (e.g., during the preceding year for FOBT and during the preceding 5 years for sigmoidoscopy/proctoscopy) by gender, race/ethnicity, and age.

## RESULTS

### All Sites Combined

Joinpoint analyses revealed three trends in overall cancer incidence rates from 1973–1997 for all sites combined, both genders, and all races combined: slightly increasing on average 0.9% per year from 1973–1983 and steadily increasing on average 1.8% per year from 1983–1992, followed by a steadily decreasing rate of -1.3% per year from 1992–1997 (Fig. 1) (Table 1). However, the trends varied by gender and race (Fig. 2). The steadily increasing incidence rates in white men sharply accelerated to an average of 5.2% per year between 1989–1992 but dropped sharply, an average of -5.1% per year, between 1992–1995 followed by a leveling off through 1997. Similarly, black men experienced a sharp increase in the cancer incidence rates between 1989–1993 followed by a sharp drop of -4.6% per year after 1993. In contrast, cancer incidence rates for white and black women steadily increased until 1987 and 1991, respectively, and then leveled off.

The long term trend of the increasing overall cancer death rates (i.e., all sites, both genders, and all races combined) began to slow in the mid-1980s and then reversed to a decline after 1991 with a more rapid decline after 1995 (Fig. 1) (Table 2). Cancer death rates in white men began to decline after 1990 and decreased more rapidly after 1994. Among black men, the rate of increase in cancer death rates began to slow after 1983 with a downturn in death rates beginning after 1991. Cancer death rates for women increased slightly prior to 1990 and then leveled off after 1990 in white women and declined slightly after 1991 in black women.

**TABLE 1**
**Cancer Incidence Rates[a] and Trends for 1990–1997 and Joinpoint Analyses[b] for 1973–1997 by Site, Gender, and Race**

| | | | Joinpoint analyses (1973–1997) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Trend 1 | | Trend 2 | | Trend 3 | | Trend 4 | |
| Site | Average annual rate[a] (1990–1997) | APC (1990–1997) | Range of years | APC | Range of years | APC | Range of years | APC | Range of years | APC |
| All sites | 398.1 | −0.8 | 1973–1983 | 0.9[c] | 1983–1992 | 1.8[c] | 1992–1997 | −1.3[c] | | |
| Male | 478.0 | −1.7[c] | 1973–1989 | 1.4[c] | 1989–1992 | 5.2[c] | 1992–1995 | −4.6[c] | 1995–1997 | −0.8 |
| White | 476.3 | −2.1[c] | 1973–1989 | 1.4[c] | 1989–1992 | 5.2[c] | 1992–1995 | −5.1[c] | 1995–1997 | −0.9 |
| Black | 597.9 | −1.0 | 1973–1981 | 2.6[c] | 1981–1989 | 0.8[c] | 1989–1993 | 5.4[c] | 1993–1997 | −4.6[c] |
| Female | 343.5 | −0.1 | 1973–1980 | 0.2 | 1980–1987 | 1.7[c] | 1987–1997 | 0.2 | | |
| Black | 337.4 | −0.2 | 1973–1991 | 1.1[c] | 1991–1997 | −0.2 | | | | |
| White | 352.4 | −0.2 | 1973–1980 | 0.3 | 1980–1987 | 1.8[c] | 1987–1997 | 0.1 | | |
| Lung | 55.2 | −1.6[c] | 1973–1976 | 4.1[c] | 1976–1982 | 2.4[c] | 1982–1991 | 0.9[c] | 1991–1997 | −1.5[c] |
| Male | 73.3 | −2.8[c] | 1973–1981 | 1.9[c] | 1981–1992 | −0.5[c] | 1992–1997 | −3.2[c] | | |
| White | 71.9 | −3.0[c] | 1973–1980 | 1.9[c] | 1980–1991 | −0.3 | 1991–1997 | −2.9[c] | | |
| Black | 111.1 | −2.4[c] | 1973–1984 | 2.9[c] | 1984–1997 | −1.8[c] | | | | |
| Female | 41.6 | −0.1 | 1973–1976 | 9.1[c] | 1976–1983 | 5.2[c] | 1983–1991 | 3.1[c] | 1991–1997 | 0.0 |
| White | 43.3 | 0.2 | 1973–1976 | 10.6[c] | 1976–1988 | 4.7[c] | 1988–1997 | 0.9[c] | | |
| Black | 45.8 | −1.3 | 1973–1990 | 5.0[c] | 1990–1997 | −1.5 | | | | |
| Prostate | 149.7 | −2.1 | 1973–1988 | 2.8[c] | 1988–1992 | 17.5[c] | 1992–1995 | −10.3[c] | 1995–1997 | 0.7 |
| White | 145.8 | −3.0 | 1973–1988 | 3.0[c] | 1988–1992 | 17.5[c] | 1992–1995 | −11.7[c] | 1995–1997 | 1.0 |
| Black | 225.0 | 0.7 | 1973–1989 | 2.2[c] | 1989–1992 | 21.8[c] | 1992–1997 | −4.7[c] | | |
| Female breast | 109.7 | 0.4 | 1973–1980 | −0.6 | 1980–1987 | 3.8[c] | 1987–1997 | 0.2 | | |
| White | 114.0 | 0.3 | 1973–1980 | −0.5 | 1980–1987 | 4.0[c] | 1987–1997 | 0.1 | | |
| Black | 100.2 | 0.7[c] | 1973–1979 | −0.6 | 1979–1986 | 3.8[c] | 1986–1997 | 1.0[c] | | |
| Colon/rectum | 43.9 | −1.7[c] | 1973–1985 | 0.8[c] | 1985–1997 | −1.6[c] | | | | |
| Male | 52.9 | −2.0[c] | 1973–1985 | 1.2[c] | 1985–1991 | −1.2[c] | 1991–1995 | −3.3[c] | 1995–1997 | 1.8 |
| White | 52.7 | −2.3[c] | 1973–1985 | 1.1[c] | 1985–1991 | −1.3[c] | 1991–1995 | −3.5[c] | 1995–1997 | 1.5 |
| Black | 58.3 | −1.6 | 1973–1980 | 4.4[c] | 1980–1997 | 0.0 | | | | |
| Female | 37.1 | −1.5[c] | 1973–1984 | 0.5[c] | 1984–1997 | −1.6[c] | | | | |
| White | 36.6 | −1.5[c] | 1973–1984 | 0.5[c] | 1984–1997 | −1.8[c] | | | | |
| Black | 45.2 | −1.2 | 1973–1980 | 2.8[c] | 1980–1997 | −0.3 | | | | |
| Urinary bladder | 16.4 | −1.0[c] | 1973–1987 | 0.9[c] | 1987–1997 | −0.4[c] | | | | |
| Male | 28.4 | −1.3[c] | 1973–1987 | 1.1[c] | 1987–1997 | −0.8[c] | | | | |
| White | 31.0 | −1.3[c] | 1973–1988 | 1.2[c] | 1988–1997 | −1.0[c] | | | | |
| Black | 15.5 | −1.9 | 1973–1977 | 10.3[c] | 1977–1997 | −0.2 | | | | |
| Female | 7.4 | −0.8[c] | 1973–1975 | 6.6 | 1975–1997 | 0.2[c] | | | | |
| White | 7.9 | −0.7 | 1973–1997 | 0.6[c] | | | | | | |
| Black | 6.0 | −1.9 | 1973–1997 | 0.5 | | | | | | |
| Non-Hodgkin lymphoma | 15.5 | 0.6 | 1973–1991 | 3.4[c] | 1991–1997 | 0.5 | | | | |
| Male | 19.4 | 0.5 | 1973–1991 | 3.9[c] | 1991–1997 | 0.4 | | | | |
| White | 20.1 | 0.2 | 1973–1979 | 2.6[c] | 1979–1990 | 4.7[c] | 1990–1997 | 0.0 | | |
| Black | 15.7 | 2.3 | 1973–1997 | 4.3[c] | | | | | | |
| Female | 12.2 | 0.7[c] | 1973–1990 | 2.9[c] | 1990–1997 | 0.8 | | | | |
| White | 12.8 | 0.2 | 1973–1990 | 2.9[c] | 1990–1997 | 0.5 | | | | |
| Black | 8.5 | 1.5 | 1973–1997 | 3.4[c] | | | | | | |
| Melanoma | 12.4 | 2.6[c] | 1973–1981 | 6.1[c] | 1981–1997 | 2.8[c] | | | | |
| Male | 15.3 | 2.9[c] | 1973–1981 | 6.9[c] | 1981–1997 | 3.5[c] | | | | |
| White | 17.4 | 3.0[c] | 1973–1981 | 7.2[c] | 1981–1997 | 3.6[c] | | | | |
| Black | 1.1 | 4.5 | 1973–1997 | 2.9 | | | | | | |
| Female | 10.2 | 2.2[c] | 1973–1981 | 5.6[c] | 1981–1997 | 2.0[c] | | | | |
| White | 11.9 | 2.6[c] | 1973–1980 | 6.7[c] | 1980–1997 | 2.2[c] | | | | |
| Black | 0.7 | −0.4 | 1973–1997 | −1.1 | | | | | | |
| Uterine corpus, NOS | 21.2 | 0.1 | 1973–1975 | 6.9[c] | 1975–1979 | −6.5[c] | 1979–1988 | −1.9[c] | 1988–1997 | 0.5[c] |
| White | 22.5 | −0.2 | 1973–1975 | 7.6[c] | 1975–1979 | −6.7[c] | 1979–1988 | −1.8[c] | 1988–1997 | 0.4 |
| Black | 15.0 | 1.5 | 1973–1997 | 0.0 | | | | | | |

(*continued*)

TABLE 1 (*continued*)

| Site | Average annual rate[a] (1990–1997) | APC (1990–1997) | Joinpoint analyses (1973–1997) Trend 1 Range of years | Trend 1 APC | Trend 2 Range of years | Trend 2 APC | Trend 3 Range of years | Trend 3 APC | Trend 4 Range of years | Trend 4 APC |
|---|---|---|---|---|---|---|---|---|---|---|
| Oral cavity/pharynx | 10.1 | −1.8[c] | 1973–1981 | 0.8[c] | 1981–1997 | −1.1[c] | | | | |
| Male | 15.1 | −2.1[c] | 1973–1983 | 0.2 | 1983–1997 | −1.3[c] | | | | |
| White | 14.8 | −2.2[c] | 1973–1983 | −0.1 | 1983–1997 | −1.4[c] | | | | |
| Black | 20.3 | −2.7 | 1973–1981 | 6.2[c] | 1981–1997 | −1.4[c] | | | | |
| Female | 5.9 | −1.3[c] | 1973–1981 | 1.5[c] | 1981–1997 | −1.1[c] | | | | |
| White | 5.9 | −1.5[c] | 1973–1981 | 1.6[c] | 1981–1997 | −1.0[c] | | | | |
| Black | 6.0 | 0.5 | 1973–1997 | −0.6 | | | | | | |
| Leukemia | 10.4 | −1.5[c] | 1973–1995 | 0.0 | 1995–1997 | −5.3 | | | | |
| Male | 13.4 | −1.7[c] | 1973–1989 | 0.2 | 1989–1997 | −1.5[c] | | | | |
| White | 14.0 | −2.0[c] | 1973–1992 | 0.1 | 1992–1997 | −2.7[c] | | | | |
| Black | 10.8 | −2.6 | 1973–1997 | −0.5 | | | | | | |
| Female | 8.0 | −1.2[c] | 1973–1997 | −0.2 | | | | | | |
| White | 8.3 | −1.0 | 1973–1997 | −0.1 | | | | | | |
| Black | 6.8 | −3.0[c] | 1973–1997 | −0.7[c] | | | | | | |
| Pancreas | 8.8 | −0.8[c] | 1973–1979 | −1.3[c] | 1979–1983 | 1.4 | 1983–1997 | −0.7[c] | | |
| Male | 10.1 | −1.0[c] | 1973–1997 | −0.8[c] | | | | | | |
| White | 9.8 | −1.1[c] | 1973–1997 | −1.0[c] | | | | | | |
| Black | 14.8 | −0.7 | 1973–1997 | −0.4 | | | | | | |
| Female | 7.8 | −0.8[c] | 1973–1985 | 0.8[c] | 1985–1997 | −0.6[c] | | | | |
| White | 7.5 | −0.9[c] | 1973–1984 | 0.8[c] | 1984–1997 | −0.6[c] | | | | |
| Black | 12.1 | 0.7 | 1973–1997 | 0.3 | | | | | | |
| Ovary | 14.7 | −1.3[c] | 1973–1980 | −1.4[c] | 1980–1991 | 1.5[c] | 1991–1997 | −1.1 | | |
| White | 15.6 | −1.3[c] | 1973–1981 | −1.1[c] | 1981–1991 | 1.8[c] | 1991–1997 | −1.2 | | |
| Black | 10.3 | −1.4 | 1973–1997 | 0.2 | | | | | | |
| Stomach | 7.6 | −1.7[c] | 1973–1997 | −1.6[c] | | | | | | |
| Male | 11.1 | −1.7[c] | 1973–1997 | −1.6[c] | | | | | | |
| White | 9.6 | −2.0[c] | 1973–1997 | −1.9[c] | | | | | | |
| Black | 17.0 | −1.9 | 1973–1997 | −1.1[c] | | | | | | |
| Female | 4.9 | −2.1[c] | 1973–1997 | −1.8[c] | | | | | | |
| White | 4.1 | −3.0[c] | 1973–1997 | −2.3[c] | | | | | | |
| Black | 7.6 | −0.5 | 1973–1997 | −1.1[c] | | | | | | |
| Brain | 5.9 | −1.5[c] | 1973–1988 | 1.5[c] | 1988–1997 | −0.9[c] | | | | |
| Male | 7.0 | −1.4[c] | 1973–1989 | 1.3[c] | 1989–1997 | −0.9 | | | | |
| White | 7.6 | −1.4[c] | 1973–1989 | 1.4[c] | 1989–1997 | −0.9 | | | | |
| Black | 4.4 | 0.7 | 1973–1997 | 0.4 | | | | | | |
| Female | 5.0 | −1.6[c] | 1973–1987 | 1.7[c] | 1987–1997 | −1.0[c] | | | | |
| White | 5.4 | −1.6[c] | 1973–1987 | 1.9[c] | 1987–1997 | −1.1[c] | | | | |
| Black | 3.3 | −2.8 | 1973–1997 | 1.2 | | | | | | |

APC: annual percent change; NOS: not otherwise specified.

[a] Incidence data are from 11 Surveillance, Epidemiology, and End Results (SEER) registries covering 14 percent of the U.S. population. Rates are per 100,000 persons and are age-adjusted to the 1970 U.S. standard million population.

[b] Joinpoint analysis of trends allowed for up to three joinpoints. Incidence data are from 9 Surveillance, Epidemiology, and End Results (SEER) registries covering 10% of U.S. population.

[c] The annual percent change (APC) is statistically significantly different from 0 (two-sided $P < 0.05$).

### Trends between 1990 and 1997

The recent trends for various primary sites by race and gender can be evaluated in a more equitable way by comparing the APC over a single time period, 1990–1997. For all cancer sites combined, SEER incidence rates decreased (-0.8% per year) (Fig. 3) although the trend did not achieve statistical significance. The U.S. cancer death rates for all sites combined decreased significantly (–0.8%), the same amount as the incidence rate during 1990–1997 (Fig. 4).

**TABLE 2**
**U.S. Cancer Death Rates[a] and Trends for 1990–1997 and Joinpoint Analyses[b] for 1973–1997, by Site, Gender, and Race**

| | | | Joinpoint analyses[b] (1973–1997) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Trend 1 | | Trend 2 | | Trend 3 | | Trend 4 | |
| Site | Average annual rate[a] (1990–1997) | APC (1990–1997) | Range of years | APC | Range of years | APC | Range of years | APC | Range of years | APC |
| All sites | 169.9 | −0.8[c] | 1973–1984 | 0.5[c] | 1984–1991 | 0.2[c] | 1991–1995 | −0.6[c] | 1995–1997 | −1.7[c] |
| Male | 213.1 | −1.2[c] | 1973–1980 | 0.7[c] | 1980–1990 | 0.2[c] | 1990–1994 | −0.8[c] | 1994–1997 | −1.9[c] |
| White | 207.0 | −1.2[c] | 1973–1979 | 0.7[c] | 1979–1990 | 0.2[c] | 1990–1994 | −0.7[c] | 1994–1997 | −1.9[c] |
| Black | 305.5 | −1.6[c] | 1973–1983 | 1.7[c] | 1983–1991 | 0.6[c] | 1991–1997 | −1.7[c] | | |
| Female | 140.5 | −0.4[c] | 1973–1990 | 0.5[c] | 1990–1995 | −0.2 | 1995–1997 | −1.4 | | |
| White | 139.1 | −0.4[c] | 1973–1990 | 0.5[c] | 1990–1995 | −0.1 | 1995–1997 | −1.4 | | |
| Black | 167.7 | −0.4[c] | 1973–1975 | −1.3 | 1975–1991 | 0.9[c] | 1991–1997 | −0.5[c] | | |
| Lung | 49.5 | −0.5[c] | 1973–1980 | 2.9[c] | 1980–1990 | 1.7[c] | 1990–1997 | −0.5[c] | | |
| Male | 71.1 | −1.7[c] | 1973–1978 | 2.2[c] | 1978–1984 | 1.0[c] | 1984–1990 | 0.3[c] | 1990–1997 | −1.7[c] |
| White | 69.5 | −1.6[c] | 1973–1980 | 1.8[c] | 1980–1990 | 0.5[c] | 1990–1997 | −1.6[c] | | |
| Black | 99.5 | −2.2[c] | 1973–1982 | 2.9[c] | 1982–1990 | 1.1[c] | 1990–1997 | −2.1[c] | | |
| Female | 33.4 | 1.2[c] | 1973–1978 | 6.8[c] | 1978–1983 | 5.6[c] | 1983–1990 | 4.0[c] | 1990–1997 | 1.3[c] |
| White | 34.0 | 1.3[c] | 1973–1976 | 7.5[c] | 1976–1983 | 5.9[c] | 1983–1991 | 3.8[c] | 1991–1997 | 1.0[c] |
| Black | 33.0 | 1.0[c] | 1973–1981 | 6.6[c] | 1981–1990 | 4.1[c] | 1990–1997 | 1.0[c] | | |
| Prostate | 25.4 | −2.2[c] | 1973–1987 | 0.8[c] | 1987–1991 | 2.8[c] | 1991–1994 | −1.2 | 1994–1997 | −4.4[c] |
| White | 23.3 | −2.4[c] | 1973–1985 | 0.6[c] | 1985–1991 | 2.2[c] | 1991–1994 | −1.1 | 1994–1997 | −4.6[c] |
| Black | 54.1 | −1.1[c] | 1973–1993 | 1.9[c] | 1993–1997 | −2.3[c] | | | | |
| Female breast | 25.6 | −2.1[c] | 1973–1979 | −0.2 | 1979–1990 | 0.4[c] | 1990–1997 | −2.2[c] | | |
| White | 25.3 | −2.4[c] | 1973–1979 | −0.2 | 1979–1989 | 0.4[c] | 1989–1995 | −1.8[c] | 1995–1997 | −4.1[c] |
| Black | 31.4 | −0.2 | 1973–1991 | 1.3[c] | 1991–1997 | −0.3 | | | | |
| Colon/rectum | 17.6 | −1.8[c] | 1973–1984 | −0.6[c] | 1984–1997 | −1.8[c] | | | | |
| Male | 21.6 | −2.1[c] | 1973–1985 | −0.1 | 1985–1997 | −1.8[c] | | | | |
| White | 21.3 | −2.2[c] | 1973–1978 | 0.4 | 1978–1986 | −0.6[c] | 1986–1997 | −2.0[c] | | |
| Black | 27.7 | −0.7[c] | 1973–1989 | 1.3[c] | 1989–1997 | −0.6 | | | | |
| Female | 14.7 | −1.7[c] | 1973–1984 | −1.1[c] | 1984–1997 | −1.9[c] | | | | |
| White | 14.3 | −1.8[c] | 1973–1984 | −1.2[c] | 1984–1997 | −2.1[c] | | | | |
| Black | 19.9 | −1.0[c] | 1973–1985 | 0.5[c] | 1985–1997 | −0.7[c] | | | | |
| Urinary bladder | 3.2 | −0.3 | 1973–1977 | −0.9[c] | 1977–1987 | −2.3[c] | 1987–1997 | 0.0 | | |
| Male | 5.6 | −0.7[c] | 1973–1976 | 0.1 | 1976–1987 | −2.1[c] | 1987–1997 | −0.4[c] | | |
| White | 5.8 | −0.5[c] | 1973–1976 | 0.1 | 1976–1987 | −2.1[c] | 1987–1997 | −0.3[c] | | |
| Black | 4.5 | −2.5[c] | 1973–1997 | −1.4[c] | | | | | | |
| Female | 1.7 | 0.0 | 1973–1987 | −1.8[c] | 1987–1997 | 0.1 | | | | |
| White | 1.7 | 0.2 | 1973–1987 | −1.8[c] | 1987–1997 | 0.2 | | | | |
| Black | 2.3 | −0.7 | 1973–1997 | −1.2[c] | | | | | | |
| Non-Hodgkin lymphoma | 6.7 | 1.7[c] | 1973–1976 | −0.9 | 1976–1997 | 2.1[c] | | | | |
| Male | 8.3 | 1.5[c] | 1973–1976 | −1.4 | 1976–1997 | 2.2[c] | | | | |
| White | 8.6 | 1.5[c] | 1973–1977 | −0.3 | 1977–1997 | 2.2[c] | | | | |
| Black | 6.2 | 2.3[c] | 1973–1979 | −0.7 | 1979–1997 | 2.9[c] | | | | |
| Female | 5.4 | 1.8[c] | 1973–1975 | −1.5 | 1975–1997 | 1.9[c] | | | | |
| White | 5.7 | 1.9[c] | 1973–1975 | −1.7 | 1975–1997 | 1.9[c] | | | | |
| Black | 3.7 | 1.6[c] | 1973–1997 | 2.4[c] | | | | | | |
| Melanoma | 2.2 | 0.1 | 1973–1977 | 4.1[c] | 1977–1989 | 1.3[c] | 1989–1997 | 0.1 | | |
| Male | 3.2 | 0.4 | 1973–1987 | 2.5[c] | 1987–1997 | 0.6[c] | | | | |
| White | 3.5 | 0.5[c] | 1973–1987 | 2.6[c] | 1987–1997 | 0.7[c] | | | | |
| Black | 0.4 | −4.0 | 1973–1997 | −1.1[c] | | | | | | |
| Female | 1.5 | −0.3 | 1973–1979 | 3.0[c] | 1979–1997 | 0.0 | | | | |
| White | 1.7 | −0.3 | 1973–1979 | 3.1[c] | 1979–1997 | 0.2 | | | | |
| Black | 0.4 | −0.8 | 1973–1997 | 0.2 | | | | | | |
| Uterine corpus, NOS | 3.3 | −0.7[c] | 1973–1989 | −1.7[c] | 1989–1997 | −0.7[c] | | | | |
| White | 3.1 | −0.7[c] | 1973–1991 | −1.7[c] | 1991–1997 | −0.4 | | | | |
| Black | 5.8 | −1.0 | 1973–1997 | −1.1[c] | | | | | | |

(*continued*)

TABLE 2 (*continued*)

| Site | Average annual rate[a] (1990–1997) | APC (1990–1997) | Joinpoint analyses[b] (1973–1997) Trend 1 Range of years | Trend 1 APC | Trend 2 Range of years | Trend 2 APC | Trend 3 Range of years | Trend 3 APC | Trend 4 Range of years | Trend 4 APC |
|---|---|---|---|---|---|---|---|---|---|---|
| Oral cavity/pharynx | 2.7 | −2.6[c] | 1973–1979 | −0.2 | 1979–1997 | −1.9[c] | | | | |
| Male | 4.2 | −2.8[c] | 1973–1979 | −0.6 | 1979–1997 | −2.1[c] | | | | |
| White | 3.8 | −2.6[c] | 1973–1977 | −1.0 | 1977–1997 | −2.3[c] | | | | |
| Black | 8.4 | −3.8[c] | 1973–1980 | 3.8[c] | 1980–1993 | −1.3[c] | 1993–1997 | −4.8[c] | | |
| Female | 1.5 | −2.3[c] | 1973–1979 | 0.5 | 1979–1991 | −1.4 | 1991–1997 | −2.5[c] | | |
| White | 1.5 | −2.3[c] | 1973–1979 | 0.6 | 1979–1997 | −1.7[c] | | | | |
| Black | 2.1 | −2.5[c] | 1973–1981 | 1.4 | 1981–1997 | −1.4[c] | | | | |
| Leukemia | 6.3 | −0.4[c] | 1973–1997 | −0.3[c] | | | | | | |
| Male | 8.3 | −0.4 | 1973–1997 | −0.3[c] | | | | | | |
| White | 8.5 | −0.3 | 1973–1997 | −0.3[c] | | | | | | |
| Black | 7.8 | −0.7 | 1973–1997 | 0.4[c] | | | | | | |
| Female | 4.8 | −0.7[c] | 1973–1997 | −0.3[c] | | | | | | |
| White | 4.9 | −0.6[c] | 1973–1997 | −0.4[c] | | | | | | |
| Black | 4.6 | −0.7 | 1973–1981 | 1.3[c] | 1981–1997 | −0.3 | | | | |
| Pancreas | 8.4 | −0.4[c] | 1973–1997 | −0.2[c] | | | | | | |
| Male | 9.8 | −0.7[c] | 1973–1997 | −0.6[c] | | | | | | |
| White | 9.6 | −0.5[c] | 1973–1986 | −0.9[c] | 1986–1997 | −0.3[c] | | | | |
| Black | 13.8 | −1.6[c] | 1973–1992 | 0.4[c] | 1992–1997 | −2.4[c] | | | | |
| Female | 7.2 | −0.2 | 1973–1984 | 0.6[c] | 1984–1997 | 0.0 | | | | |
| White | 7.0 | −0.1 | 1973–1983 | 0.5[c] | 1983–1997 | 0.1 | | | | |
| Black | 10.4 | −0.2 | 1973–1984 | 2.0[c] | 1984–1997 | 0.2 | | | | |
| Ovary | 7.6 | −0.9[c] | 1973–1984 | −1.0[c] | 1984–1991 | 0.4 | 1991–1997 | −1.0[c] | | |
| White | 7.9 | −0.9[c] | 1973–1976 | 0.5 | 1976–1980 | −2.2[c] | 1980–1994 | 0.0 | 1994–1997 | −1.7 |
| Black | 6.4 | −1.0 | 1973–1997 | −0.2 | | | | | | |
| Stomach | 4.3 | −2.8[c] | 1973–1977 | −3.3[c] | 1977–1987 | −2.4[c] | 1987–1990 | −0.6 | 1990–1997 | −2.8[c] |
| Male | 6.2 | −3.1[c] | 1973–1978 | −3.3[c] | 1978–1991 | −1.9[c] | 1991–1997 | −3.1[c] | | |
| White | 5.5 | −3.4[c] | 1973–1978 | −3.4[c] | 1978–1991 | −2.1[c] | 1991–1997 | −3.3[c] | | |
| Black | 12.3 | −2.8[c] | 1973–1997 | −1.6[c] | | | | | | |
| Female | 2.9 | −2.6[c] | 1973–1987 | −2.8[c] | 1987–1990 | −0.5 | 1990–1997 | −2.5[c] | | |
| White | 2.5 | −3.0[c] | 1973–1987 | −3.1[c] | 1987–1990 | −0.8 | 1990–1997 | −3.0[c] | | |
| Black | 5.4 | −2.2[c] | 1973–1997 | −1.5[c] | | | | | | |
| Brain | 4.2 | −0.7[c] | 1973–1977 | 1.2[c] | 1977–1980 | 6.9[c] | 1980–1991 | 0.9[c] | 1991–1997 | −0.6 |
| Male | 5.1 | −0.8[c] | 1973–1977 | 1.5 | 1977–1980 | 7.1[c] | 1980–1991 | 0.8[c] | 1991–1997 | −0.8 |
| White | 5.4 | −0.7[c] | 1973–1977 | 1.4 | 1977–1980 | 8.0[c] | 1980–1997 | 0.5[c] | | |
| Black | 3.0 | −1.3 | 1973–1986 | 3.0[c] | 1986–1997 | −0.8 | | | | |
| Female | 3.5 | −0.6 | 1973–1977 | 1.1 | 1977–1980 | 6.6[c] | 1980–1991 | 0.9[c] | 1991–1997 | −0.5 |
| White | 3.7 | −0.6 | 1973–1977 | 1.1 | 1977–1980 | 7.5 | 1980–1997 | 0.6[c] | | |
| Black | 2.1 | 0.1 | 1973–1975 | −9.9 | 1975–1979 | 9.4[c] | 1979–1997 | 0.8[c] | | |

APC: annual percent change; NOS: not otherwise specified.

[a] Rates are per 100,000 persons and are age-adjusted to the 1970 U.S. standard million population.

[b] Joinpoint analysis of trends allowed for up to three joinpoints. Death data are from National Center for Health Statistics (NCHS) covering the entire U.S. population.

[c] The annual percent change is statistically significantly different from 0 (two-sided $P < 0.05$).

The recent trends in cancer incidence and death rates varied not only by gender but also by age at diagnosis or death. During 1990–1997, statistically significant decreases in incidence rates for all sites combined occurred in men who were ages 25–44 years and men age ≥ 75 years at the time of diagnosis. Incidence trends in women were less consistent with age. Death rates for all cancers combined declined for all age groups of men and for women age < 75 years. The only significant increases in cancer death rates were noted for women age ≥ 75 years.

Among the ten leading cancer incidence sites, rates decreased between 1990–1997 for the majority of sites (Fig. 3). The only significant increases were noted

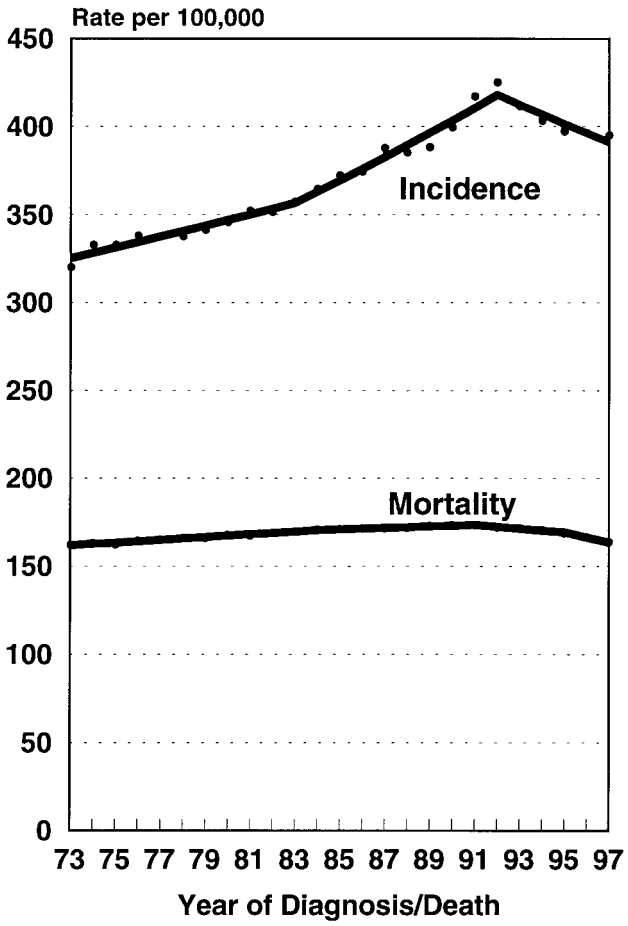


**FIGURE 1.** All cancers, incidence and death rates, for all races, both genders, with joinpoint analyses for 1973–1997. [a] Incidence data are from 9 Surveillance, Epidemiology and End Results (SEER) program areas covering 10% of U.S. population. Death data are from the National Center for Health Statistics (NCHS) covering the entire U.S. population. Rates are per 100,000 persons and age-adjusted to the 1970 U.S. standard million population.

for NHL among women and melanoma among both genders. Among men, significant declines were observed for cancers of the lung, colon/rectum, urinary bladder, and oral cavity/pharynx, and for leukemia (Fig. 3). Prostate cancer decreased with the decrease occurring primarily after 1992; however, it was not significant. For women, overall cancer incidence rates did not change appreciably between 1990–1997. Slight nonsignificant increases were found for cancers of the breast and corpus uteri and significant increases were found for NHL and melanoma. Significant declines were observed for cancer of the colon/rectum, urinary bladder cancer, leukemia, and of the oral cavity/pharynx. Female lung cancer incidence rates have leveled off in the SEER areas, but the death rates for the U.S. have not.

Among the ten leading mortality sites, rates decreased between 1990–1997 for the majority of sites (Fig. 4). The only significant increases noted were for female lung cancer and NHL for both genders. For men, significant decreases were observed in all sites combined, lung, colon/rectum, prostate, pancreas, stomach, and brain. For women, significant declines were noted for all sites combined, colon/rectum, breast, leukemia, stomach, and ovaries.

The four leading cancer incidence rate sites were the lung, prostate, female breast, and colon/rectum, and together they accounted for approximately 54% of all new diagnoses.[24] Examination of incidence rates for these four sites by race and ethnicity revealed that, with the exception of female breast cancer, blacks had higher incidence rates than whites, Hispanics, AI/AN, and API (Fig. 5). These four sites also were the leading four causes for cancer death for each of the racial/ethnic groups (Fig. 5) and accounted for $>$ 50% of the cancer deaths in the U.S.[24] Again, blacks had higher overall death rates than the other racial/ethnic groups.

### Lung and Bronchus

Trends in the incidence rates of cancer of the lung and bronchus differ by gender and race (Table 1). Rates in white men steadily increased between 1973–1980, leveling off around 1980, and then began to steadily decrease after 1991. Rates in black men steadily rose until about 1984 but have since steadily declined. In contrast, incidence rates for white women continued to increase sharply between 1973–1976 (averaging 10.6% per year) with a slowing of the increase in rates between 1976–1988 to approximately 4.7% per year, and then slowed again to 0.9% per year after 1988. After climbing an average of 5.0% per year, incidence rates for black women appeared to be leveling off around 1990.

For men, lung cancer ranks as the second highest cancer site after prostate cancer at a rate of 73.3 per 100,000. It is second highest for each of the racial/ethnic groups (Fig. 5). However, the rates vary widely, from a low of 38.0 per 100,000 for Hispanics to 111.1 for black men. The incidence rates for Hispanic, AI/AN, and API men were all less than half the rate for black men. For women, lung cancer is the second highest cancer for white and black women, but third highest for Hispanics, AI/AN, and API. Similarly, the rates varied widely by race/ethnicity from a low of 19.4 per 100,000 among Hispanics to a high of 45.8 among blacks. Lung cancer incidence rates among white women were similar to those for black women. The rates were similar among Hispanic, AI/AN, and API women.

Similar to incidence rates, trends in death rates

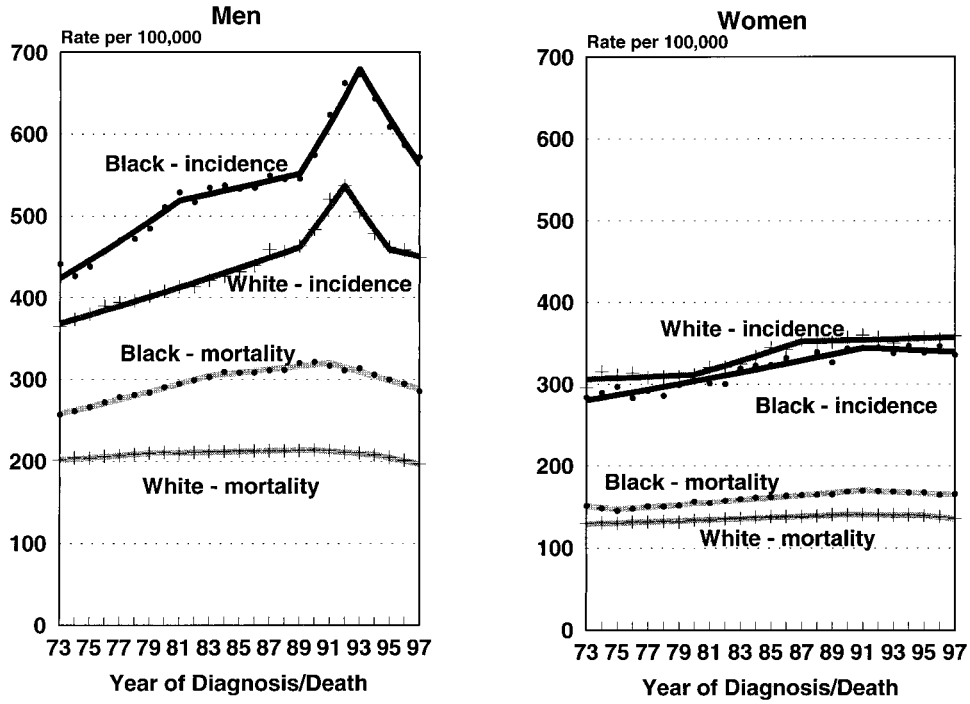


**FIGURE 2.** All cancers, incidence and death rates by gender and race, with joinpoint analyses for 1973–1997. [a] Incidence data are from 9 Surveillance, Epidemiology, and End Results (SEER) program areas covering 10% of U.S. population. Death data are from the National Center for Health Statistics (NCHS) covering the entire U.S. population. Rates are per 100,000 persons and age-adjusted to the 1970 U.S. standard million population.

from cancer of the lung and bronchus differed dramatically by gender and race. Death rates for men had increased for decades (data not shown), but the increase slowed for white men around 1980 and for black men after 1982. Death rates began to drop steadily for white men and for black men after 1990. However, death rates from cancers of the lung and bronchus among women have continued to increase over time although with progressive slowing of the rates of increase observed for both white and black women. Lung cancer is the number one cause of cancer death among men and women for all race/ethnic groups, except Hispanic women.

### Prostate

Prostate cancer incidence rates fluctuated dramatically (Table 1). Rates steadily increased for both white and black men in the 1970s and early 1980s. In white men, rates escalated rapidly, on average 17.5% per year from 1988–1992, dropped markedly (averaging -11.7% per year) from 1992–1995, and have since leveled off. Similarly, rates for black men accelerated dramatically (21.8% per year) from 1989 to around 1992 but have since continued to decline sharply (averaging -4.7% per year). Prostate cancer is the number one cancer site in men for each of the race/ethnic groups. However, the rates vary $>$ 4-fold, from 49.6 per 100,000 for AI/AN men to 225.0 for black men (Fig. 5).

In addition, death rates from prostate cancer have varied considerably over time (Table 2). Death rates in white men increased slowly during the 1970s until the mid-1980s, climbed more rapidly after 1985, reversed course to decline after 1991, but started dropping sharply (averaging -4.6% per year) after 1994. Among black men, the pattern differed in that death rates steadily increased until 1993 and since that time have steadily decreased (averaging -2.3% per year). Prostate cancer death rates among black men were more than twice those for the other race/ethnicity groups (whites, Hispanics, AI/AN, and API) (Fig. 5).

### Female Breast

Incidence rates of invasive female breast cancer in white women steadily increased between 1980–1987 but have since leveled off (Table 1). Similarly, incidence rates in black women steadily rose between 1979–1986 followed by a slowing of increasing rates since 1986. Among women, breast cancer is the number one cancer site regardless of race/ethnicity. The rates are more than double among whites (114.0 per 100,000) compared with AI/AN (45.4 per 100,000) (Fig. 5).

In contrast, breast cancer death rates in white women were level until 1979, increased slightly from 1979–1989, began to decrease steadily after 1989, and dropped sharply (averaging -4.1% per year) after 1995 (Table 2). Over the same time period, death rates for black women

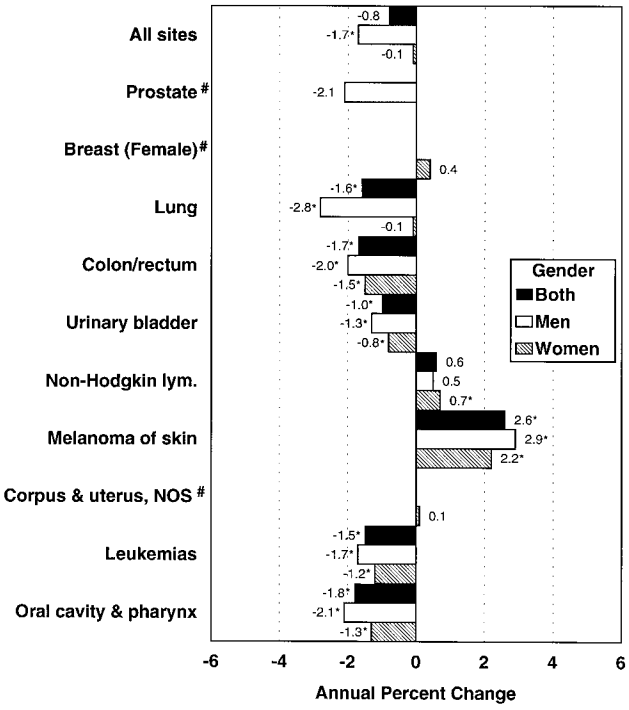


**FIGURE 3.** Annual percent change (APC) in cancer incidence rates,[a] top ten sites by gender, all ages, all races, 1990–1997. [a] Incidence data are from 11 Surveillance, Epidemiology, and End Results (SEER) program areas covering 14% of U.S. population. Rates are per 100,000 persons and age-adjusted to the 1970 U.S. standard million population. # APC is based on gender-specific rates; NOS: not otherwise specified. lym: lymphoma. * The APC is statistically significantly different from zero (2-sided $P < 0.05$).

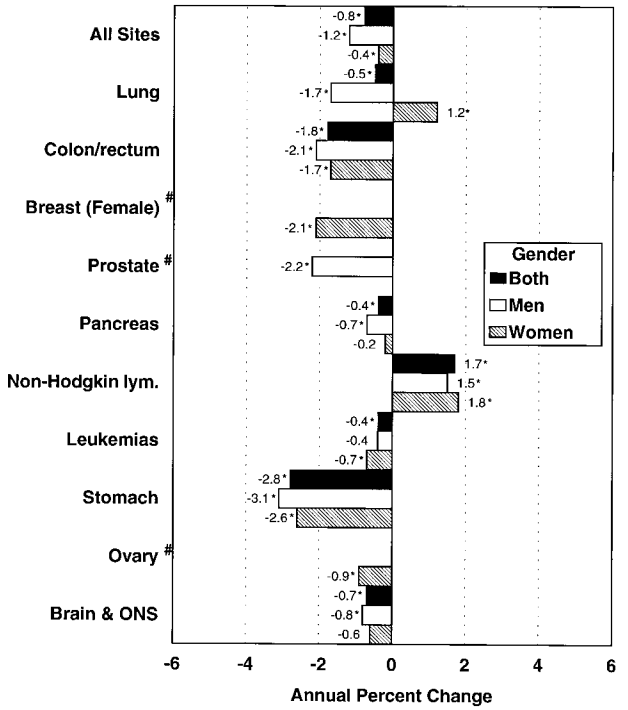


**FIGURE 4.** Annual percent change (APC) in cancer death rates,[a] top ten sites by gender, all ages, all races, 1990–1997. [a] Death data are from National Center for Health Statistics (NCHS) covering the entire U.S. population. Rates are per 100,000 persons and age-adjusted to the 1970 U.S. standard million population. # APC is based on gender specific rates. * The APC is statistically significantly different from zero (2-sided $P < 0.05$). lym: lymphoma; ONS: other nervous system.

climbed steadily but began to level off after 1991. Except for Hispanic women, breast cancer is not the number one cause of cancer death. It ranks second among all cancer deaths after lung cancer (Fig. 5).

### Urinary Bladder

Incidence rates for cancer of the urinary bladder steadily increased in white men until 1988 and subsequently declined steadily (Table 1). Incidence rates in black men sharply increased (averaging 10.3% per year) over a short period of time in the mid-1970s, after which time rates leveled off. Cancer of the urinary bladder is one site in which white men have much higher incidence rates than black men (31.0 per 100,000 vs. 15.5 per 100,000) (Fig. 5). Incidence rates are much higher among men than women.

Incidence rates for white women have increased slightly throughout the study period and remained approximately level for black women.

Death rates for carcinoma of the urinary bladder have declined steadily for black men and for black women throughout the study period (Table 2). In contrast death rates for white men remained level and did not begin to decline until after 1976, with a slowing of the decline occurring after 1987. Unlike their male or black counterparts, death rates in white women steadily declined between 1973 and 1987 and then leveled off.

### Non-Hodgkin Lymphoma

The incidence rate of NHL in white men steadily increased between 1973 and 1979, then sharply increased (averaging 4.7% per year) from 1979 to 1990 with a leveling off of the rates after approximately 1990. The rates for black men and women increased substantially (on average 4.3% and 3.4% per year, respectively) throughout the study period. White women had steady increases of NHL with a leveling off of the rates beginning around 1990.

Death rates from NHL were fairly level but have steadily increased since the mid-to-late 1970s for white men, black men, and white women. Death rates have steadily increased throughout the study period for black women.

### Melanoma of the Skin

Incidence rates for melanoma of the skin steadily increased for white men and for white women throughout the study period but a slowing in the increasing rates was observed in approximately 1981 (Table 1). The incidence rate of melanoma of the skin in blacks is very low compared with whites and has been approximately level for black men and women throughout the study period.

Death rates from melanoma of the skin increased for whites throughout the study period but a slowing in the increasing death rate was observed after 1979 for white women and after 1987 for white men (Table 2). Death rates from melanoma of the skin in blacks were quite low but appeared to decrease in black men and to remain level in black women throughout the study period.

### Corpus Uteri and Uterus, NOS

Rates of newly diagnosed cancer of the corpus and uterus, NOS in white women fluctuated substantially during the study period with sharp increases (7.6% per year) between 1973–1975, and sharp decreases (averaging -6.7% per year) between 1975–1979. Between 1979–1988, the rates continued to decrease but fell only –1.8% per year. After 1988, the incidence rates leveled off for white women (Table 1). In contrast, the incidence rates for black women have been level throughout the study period. Death rates from carcinoma of the corpus and uterus NOS steadily declined for both black and white women but leveled off after 1991 for white women (Table 2).

### Oral Cavity and Pharynx

The incidence rate of cancer of the oral cavity and pharynx was level in white men until 1983 followed by a steady decline through 1997 (Table 1). The incidence rate in white women steadily rose until 1981 followed by steady decreases throughout the remainder of the study period. Rates climbed sharply (averaging 6.2% per year) in black men until 1981 but have since steadily decreased. Rates remained level throughout the study period for black women.

Death rates for carcinoma of the oral cavity and pharynx steadily declined since 1977 for white men (Table 2). In contrast, rates increased for black men until 1980 and then began falling with a sharper drop starting after 1993. Trends for death rates for white and black women were similar, being approximately level during the 1970s followed by steady declines beginning after 1979 for white women and after 1981 for black women.

### Leukemias

The incidence rates of leukemia in white men were level in the 1970s and 1980s but began to decrease steadily after 1992 (Table 1). Incidence rates in black men and white women remained approximately level from 1973–1997 whereas rates decreased slightly among black women.

From 1973–1997, leukemia death rates for white men and women dropped slightly. Death rates in black men increased slightly throughout the study period while the rates in black women increased steadily until 1981, at which time the rates leveled off (Table 2).

### Pancreas

The incidence of pancreatic cancer decreased for white men and remained level for black men and women over the study period. For white women, the rates increased slightly until 1984 and then declined on average -0.6% per year.

Death rates from pancreatic cancer decreased for white men throughout the study period, but at a slower rate since approximately 1986. Death rates in black men did not begin to drop steadily until after 1992. Death rates in white and black women increased until 1983 and 1984, respectively, after which time the rates leveled off.

### Ovary

The incidence rates of ovarian cancer have remained level for black women and vacillated for white women between a steady decrease between 1973–1981 and a steady increase between 1981–1991 followed by a nonsignificant decline (Table 1). Trends in death rates from ovarian cancer in black women generally have remained level between 1973–1997 and fluctuated for white women, with a significant decline occurring between approximately 1976–1980 and level rates until 1994, at which time rates began to decrease slightly (Table 2).

### Stomach

The incidence rates of stomach cancer steadily decreased for whites and blacks and men and women throughout the study period. During the same time period, death rates from stomach cancer also declined for both genders as well as for blacks and whites.

### Brain

The incidence of brain cancer increased steadily before 1990 among white men and then remained approximately level (Table 1). For white women, the incidence rates increased steadily between 1973–1987 and then decreased approximately –1.1% per year. The rates for blacks remained fairly level during the study period.

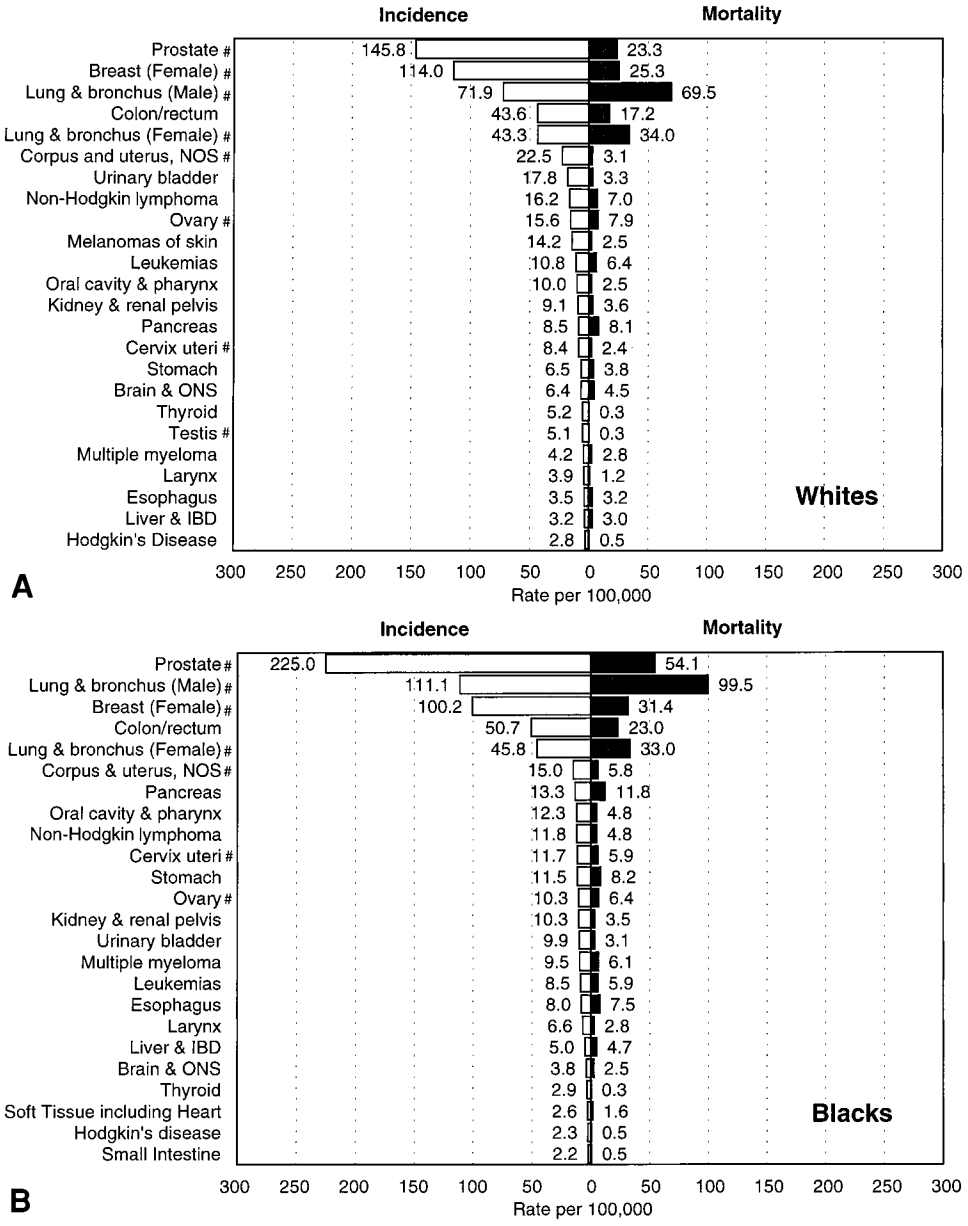


**FIGURE 5.** Cancer incidence and death rates[a] by site and race/ethnicity, 1990–1997. [a] Incidence data are from 11 Surveillance, Epidemiology, and End Result (SEER) program areas covering 14% of U.S. population. Death data are from the National Center for Health Statistics (NCHS) covering the entire U.S. population. Rates are per 100,000 persons and age-adjusted to the 1970 U.S. standard million population. [b] Hispanic is not mutually exclusive from whites, blacks, American Indians/Alaska Natives, and Asian/Pacific Islanders. [#] Rates are based on gender specific data; NOS: not otherwise specified; ONS: other nervous system; IBD: intrahepatic bile duct.

Death rates from brain cancer were level in the early-to-mid-1970s for white men, white women, and black women. Substantial increases occurred in the late 1970s, followed by a substantial slowing of the increase in rates around 1980 (Table 2). Death rates in black men steadily increased until 1986 and then leveled off.

### Liver

Liver cancer was not in the top cancer sites overall, but death rates were highest among API, as shown in Figure 5.

### Special Section on the Colon and Rectum

#### *Colorectal cancer incidence*

Overall, colon/rectum is the third highest cancer site for U.S. men (after the prostate and lung). For U.S. women, colorectal cancer ranks second to breast cancer for Hispanic, AI/AN, and API and ranks third after breast cancer and lung cancer for white and black women. Regardless of race, colorectal cancer incidence rates are higher in men than women. For all races combined, the colorectal cancer incidence rate is over 40% higher among males than females. The ACS estimates that there will be 93,800 new diagnoses

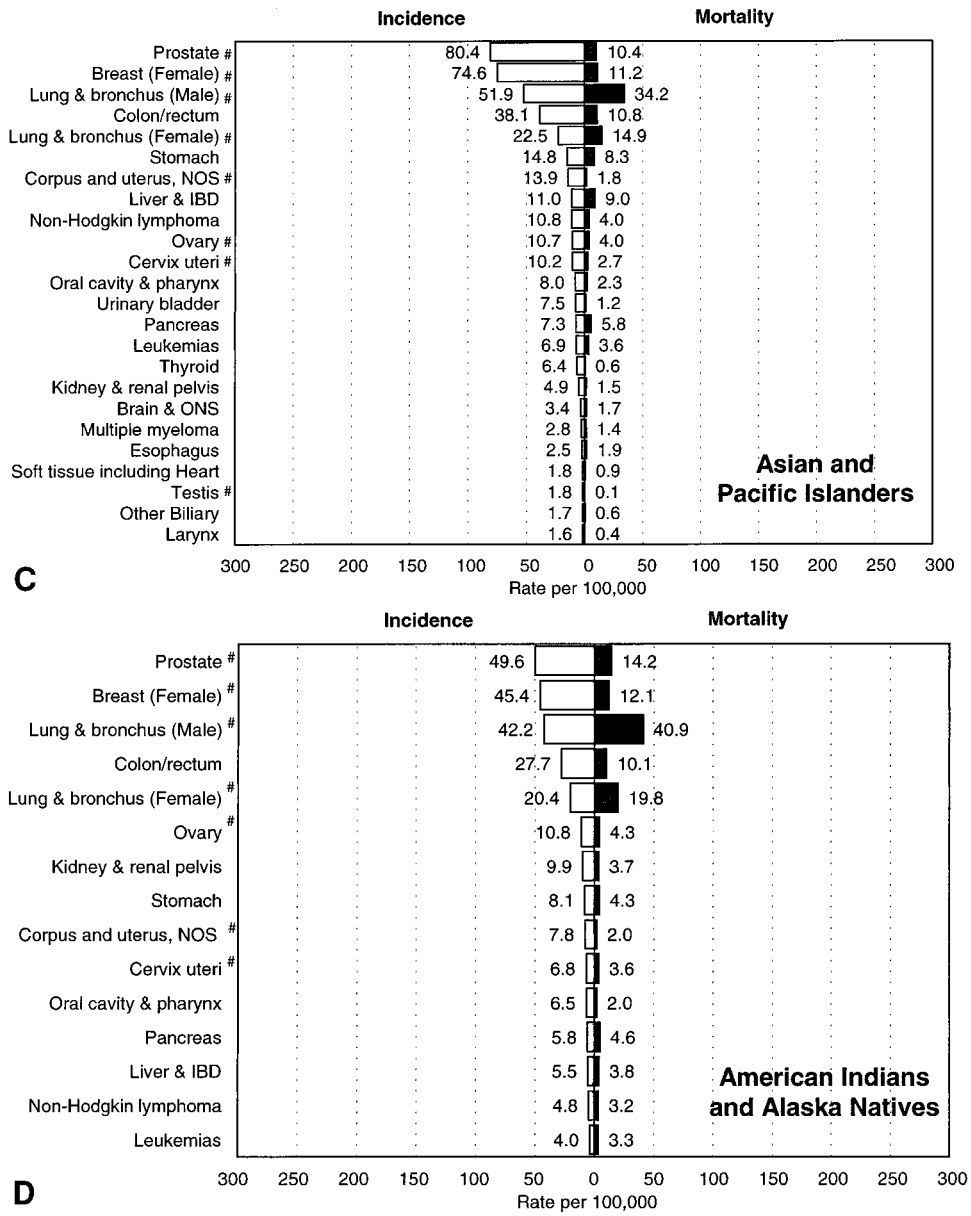


**FIGURE 5.** (*continued*)

of colon cancer and 36,400 new diagnoses of rectal cancer in the year 2000 in the U.S.[24]

The joinpoint analysis showed that the incidence rates of colorectal cancer increased until 1985 and then began decreasing steadily, an average of –1.6% per year (Fig. 6) (Table 1). In white men, colorectal cancer incidence rates began decreasing after 1985 and then declined more rapidly between 1991–1995 but leveled off subsequently (Table 1) (Fig. 7). Rates in black men increased sharply from 1973–1980 (averaging 4.4% per year) but have been level since that time. Between 1973 and 1990 the joinpoint analysis estimated lower rates for black men than for white men (Fig. 7). However, after 1990 the rates for white men dropped below those for blacks. Rates for Hispanic and AI/AN men were lower than those for white, black, or API men (Fig. 8). For white women, the incidence rates of colorectal cancer increased slightly until around 1984 but have steadily decreased since then (Table 1). After steadily rising, the colorectal cancer incidence rates in black women have been approximately level since 1980. Black women had higher incidence rates than whites and incidence rates for API, Hispanic, and AI/AN women were similar (Fig. 8).

Colorectal cancer incidence rates are low for young Americans ages 20–39 years and high for older Americans age $\geq$ 85 years. For patients age $\geq$ 50 years,

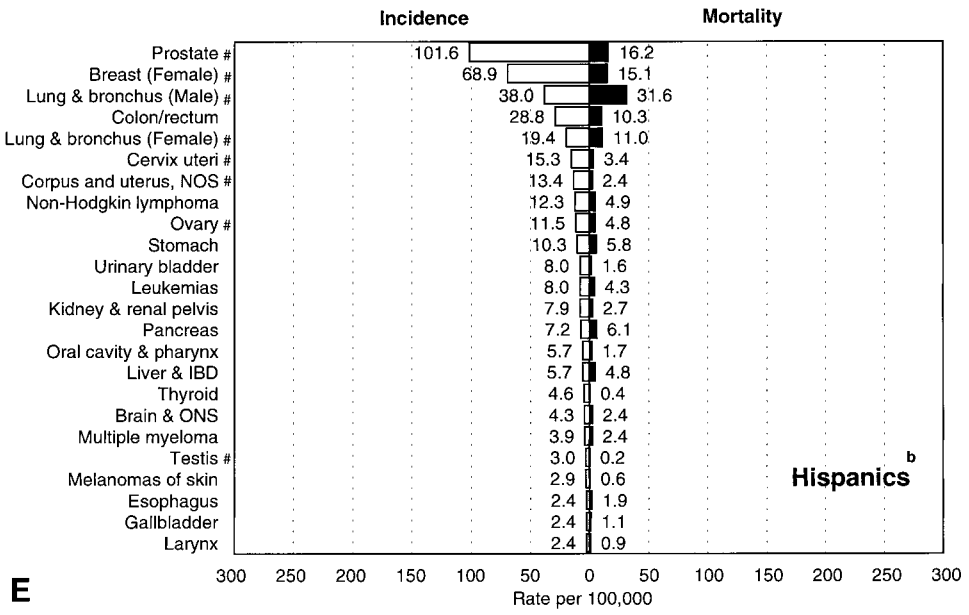


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**FIGURE 5.** (*continued*)

rates are higher for men than women. For individuals age < 50 years the rates are similar. Incidence rates for men declined later than for women. Furthermore, incidence rates declined earlier for the younger age groups than for the older groups for both genders based on trends between 1974–1997.

### *Colorectal cancer mortality*

Similar to incidence, deaths from colorectal cancer rank third after cancers of the lung and prostate for men and third after cancers of the lung and breast for women. The ACS estimates 47,700 deaths from colon cancer and 8,600 deaths from rectal cancer will occur in the year 2000.[24]

Colorectal cancer death rates in white men were level between 1973–1978 and then began to decline -0.6% per year from 1978–1986, followed by a more rapid decrease of -2.0% per year beginning around 1986 (Table 2) (Fig. 7). In contrast, death rates in black men rose steadily before 1989 and then leveled off. Before the early 1980s, colorectal cancer death rates for black men were lower than those for white men. With the rates for black men leveling off and the rates for white men declining, the rates for white men became much lower than those for black men. Colorectal cancer death rates in white women declined between 1973–1997 with a more rapid decline after 1984, averaging -2.1% per year (Table 2). In contrast, the death rates for black women did not start to decline until 1985, and the amount of decline was much less than that for white women (Fig. 7). Colorectal cancer death rates for Hispanics, AI/AN, and API were lower than those for whites or blacks (Fig. 8).

### *Long term (1950–1997) trends in colorectal cancer mortality*

For women, colorectal cancer mortality rates have been declining since 1950. In contrast, the rates for men were fairly level and then began declining in the 1980s. For ages 20–39 years and 40–49 years, colorectal cancer mortality rates declined for men since 1950. For women, the mortality rates for all age groups < 60 years have declined since 1950. For the other age groups, the decline in the rates for women started earlier than those for men in comparable age groups.

### *Incidence rates by anatomic subsite of the colon/rectum*

Incidence rates for the transverse colon were similar for blacks and whites and males and females (Fig. 9). In contrast, differences by gender and race (white vs. black) were noted for the descending colon and splenic flexure, with black men having the highest rates and white women the lowest. All anatomic subsites showed declines in the incidence rates except the right side of the colon (cecum, appendix, ascending colon, and hepatic flexure) (Fig. 9).

### *State-specific colorectal cancer occurrence*

In the most recent 5-year period (1993–1997) colorectal cancer incidence rates ranged from 32.4 new cases per 100,000 to 51.9 cases per 100,000 for both genders and all races combined among the 28 selected U.S. states and areas (Table 3). The race-specific ranges for

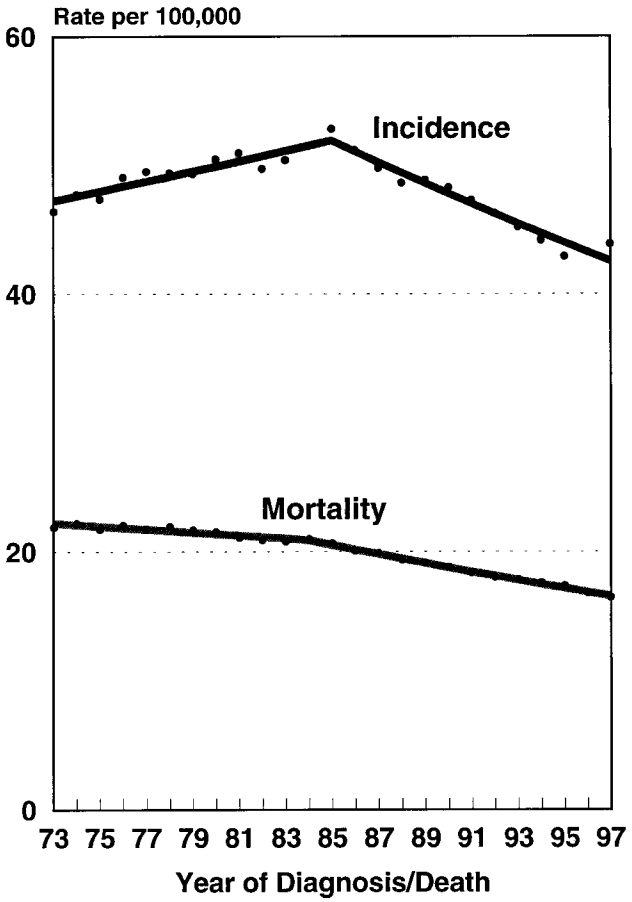


**FIGURE 6.** Colorectal cancer incidence and death rates,[a] all races, both genders, with joinpoint analyses for 1973–1997. [a] Incidence data are from 9 Surveillance, Epidemiology, and End Result (SEER) program areas covering 10% of U.S. population. Death data are from the National Center for Health Statistics (NCHS) covering the entire U.S. population. Rates are per 100,000 persons and age-adjusted to the 1970 U.S. standard million population.

both genders were similar among whites and blacks, albeit the range of rates was a little higher among blacks. Greater male/female differences were found in each area than black/white differences. Composite rates from the SEER program and NAACCR were similar with slightly higher estimates generated for all races and for whites by NAACCR and for blacks by SEER.

For 1993–1997, the state-specific death rates for colorectal cancer ranged from 12.3 per 100,000 to 20.0 per 100,000 for both genders and all races combined. Similar to incidence, the larger differences were between men and women than between black and white persons within the same state (Table 4).

### *Survival*

The overall 5-year relative survival rate for colorectal cancer was 61%. Survival rates varied by AJCC TNM stage as expected from a high of 96% for Stage I to 87% for Stage II, 55% for Stage III, and 5% for Stage IV disease. The 5-year relative survival rates did not vary by anatomic subsite of the colon/rectum as significantly and ranged from 57% for the appendix or splenic flexure to 67% for the sigmoid colon. Survival rates were similar (between 59–61%) for the cecum, hepatic flexure, transverse colon, and rectosigmoid but were higher for the ascending colon (63%), descending colon (64%), and sigmoid colon (67%). An interrelation exists between stage and segment; the appendix had both the lowest survival rate and the lowest percentage of Stage I cases (6%) whereas the sigmoid colon had the highest percentage of Stage I cases (22%). The relative survival rate for large intestine, NOS in which the segment was not specified was low (28%).

### *Screening for colorectal cancer*

According to the BRFSS in 1997, a total of 19.8% of respondents age $\geq$ 50 years reported having undergone an FOBT during the preceding year, and 30.5% of respondents reported having undergone a sigmoidoscopy/proctoscopy within the past 5 years (Table 5). More women than men reported having undergone FOBT (21.0% vs. 18.4%). More men than women reported having undergone sigmoidoscopy/proctoscopy (35.2% vs. 26.8%). The proportions of AI/AN and API who reported having undergone FOBT or sigmoidoscopy/proctoscopy were lower than for whites or blacks. A higher proportion of non-Hispanics than Hispanics reported having undergone either test. The overall proportion of respondents who reported having undergone either test increased with age until age 70–79 years, at which point it decreased with age among older respondents. The proportion who reported screening by either FOBT or sigmoidoscopy/proctoscopy increased with increasing levels of education and income and was higher among those individuals who reported having health care coverage compared with those who reported not having health care coverage (data not shown and reference 23).

The state-specific proportion of respondents reporting undergoing FOBT during the preceding years ranged from a high of 28.4% in Maine to a low of 9.2% in Mississippi (Table 6). The proportion of respondents reporting undergoing sigmoidoscopy/proctoscopy during the preceding 5 years ranged from a high of 41.5% in the District of Columbia to a low of 15.5% in Oklahoma.

Data from the NHIS indicate that there were gradual and modest increases in screening for colorectal cancer over the period 1987–1998. In 1987 approximately 24% of individuals age $\geq$ 50 years reported ever having undergone a proctoscopy/sigmoidoscopy ex-

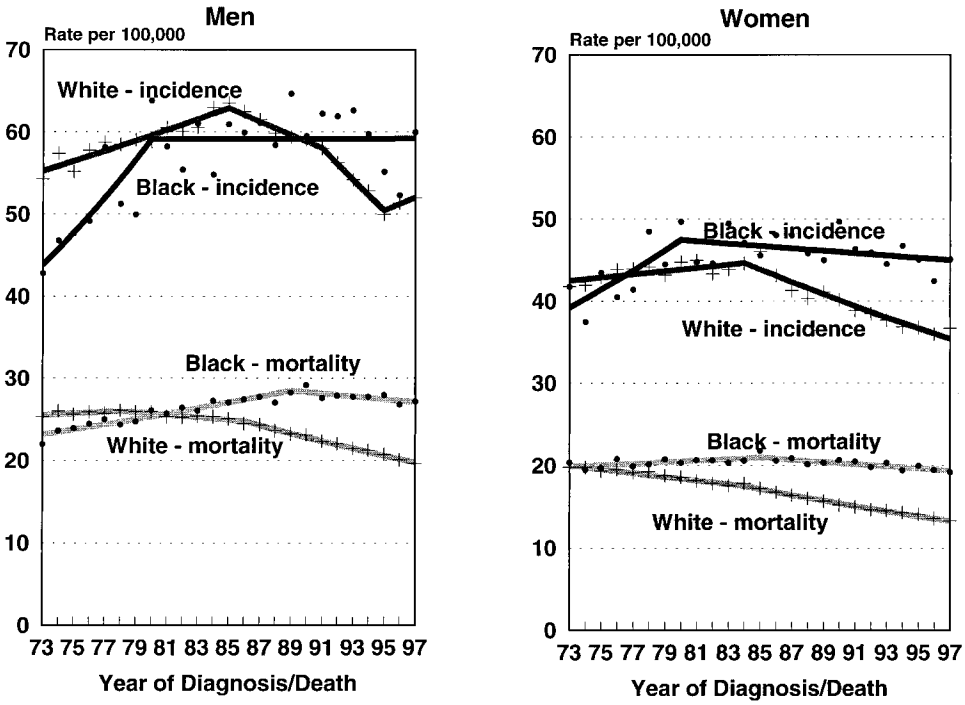


**FIGURE 7.** Colorectal cancer incidence and death rates[a] by gender and race, with joinpoint analyses for 1973–1997. [a] Incidence data are from nine Surveillance, Epidemiology, and End Results (SEER) program areas covering 10% of U.S. population. Death data are from the National Center for Health Statistics (NCHS) covering the entire U.S. population. Rates are per 100,000 persons and age-adjusted to the 1970 U.S. standard million population.

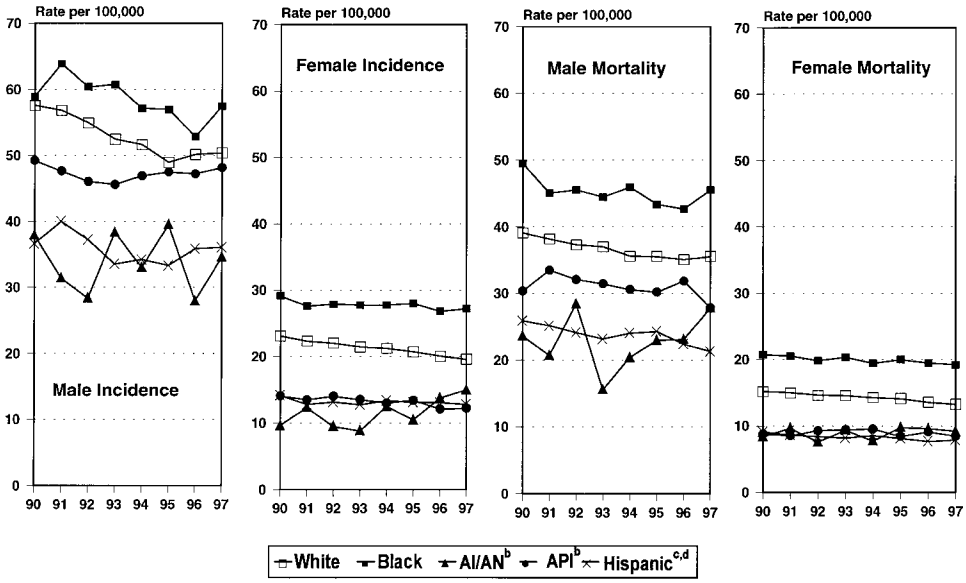


**FIGURE 8.** Colorectal cancer incidence and death rates[a] by gender and race/ethnicity, 1990–1997. [a] Incidence data are from 12 Surveillance, Epidemiology, and End Results (SEER) program areas covering 14% of U.S. population. Death data are from the National Center for Health Statistics (NCHS) covering entire U.S. population. Rates are per 100,000 persons and age-adjusted to the 1970 U.S. standard million population. [b]AI/AN: American Indians/Alaska Natives; [b]API: Asian/Pacific Islander. [c] Hispanic is not mutually exclusive from whites, blacks, American Indians/Alaska Natives, and Asian and Pacific Islanders. [d] Hispanic death rates exclude deaths that occurred in Connecticut, Louisiana, New Hampshire, and Oklahoma.

amination.[20] This proportion increased to 34% in 1992 and 38% in 1998. The proportion of individuals age ≥ 50 years who reported undergoing FOBT within 2 years before the interview increased from 30% in 1992 to 33% in 1998. [20,21] The percentage of people age ≥ 50 years who reported undergoing FOBT within 1 year increased from 15% in 1987 to 18% in 1992. NHIS rates varied by income and education, with individuals with less education or income less likely to be screened.[25]

## DISCUSSION

### Overall Cancer Incidence and Mortality Rates

Joinpoint analyses of cancer incidence and death rates confirmed the declines reported previously.[4,6] Decreases in both incidence and death rates were noted for the majority of the top ten cancer sites although the rate of decline varied by tumor type, year of downturn, gender, and race. Incidence rates for all sites combined increased slightly in the 1970s, increased at

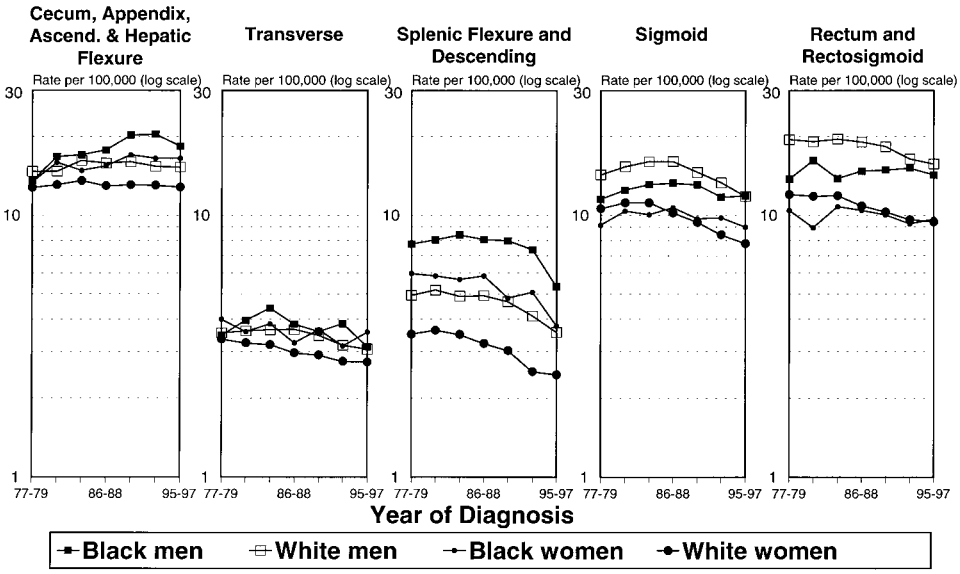


**FIGURE 9.** Colorectal[a] cancer incidence rates[b] by anatomic subsite, gender, and race, all ages, 1977–1997. [a]Colorectal excludes the large intestine, not otherwise specified.[b] Incidence rates are based on data from nine Surveillance, Epidemiology, and End Results (SEER) areas covering approximately 10% of the U.S. population. Rates are per 100,000 persons and age-adjusted to the 1970 U.S. standard million population. Ascend: ascending.

a greater pace from 1983–1992, and then declined. Death rates increased slightly over time through 1991, at which time they reversed to a significant decrease, with a more rapid decline between 1994–1997. The increased rate of decline in mortality after around 1994 occurred for all sites combined, specifically among whites, all sites combined; prostate cancer among white men; and breast cancer among white women.

Greater than 50% of all cancer cases and cancer deaths were caused by cancers of the breast, prostate, lung and bronchus, and colon/rectum. The joinpoint analysis of prostate cancer incidence rates identified four trends: a steady increase from 1973–1988, an acceleration in the increase from 1988–1992, followed by substantial decline from 1992–1995, and then approximately level rates thereafter.

In 1995, the NCI reported a significant decline in breast cancer mortality that began in 1989.[26] Like numerous other reports, the long term pattern of death rates prior to this time was described as relatively stable,[26-28] even back to the 1930s.[27] Several recent reports found slightly increasing breast cancer death rates averaging 0.2% per year ($P < 0.05$) from 1973–1989.[4,29,30] In addition to the decline beginning in 1989, the joinpoint analysis found breast cancer death rates were level during the 1970s and then were increasing on average 0.4% per year in the 1980s. This more detailed look at the trends suggests that the slightly increasing death rates previously reported for the entire time period from 1973–1989[4,29,30] were confined primarily to the 1980s.

Lung cancer mortality continues to increase significantly among women, although incidence rates in the SEER population have leveled off. Joinpoint analyses of trends in lung cancer incidence rates among women identified four time periods with progressively slower increases in rates, with the last interval (from 1991–1997) being approximately level. In contrast, lung cancer death rates among women increased throughout the study period, although, similar to the trends in incidence rates, the rates of increase progressively slowed. Further analysis of the trends in female lung cancer incidence rates in other states is needed to determine whether the differences between incidence and mortality rate trends among women in this report reflect the well known lag between changes in smoking behavior and disease onset or death or whether the SEER areas have been more successful in reducing tobacco use than the U.S. at large.

The rates of prostate cancer incidence and male lung cancer mortality are higher among blacks than any other race or ethnic group. However, three cancers, those of the prostate, female breast, and male lung, are the most common cancer incidence sites among each of the racial/ethnic populations: white, black, API, AI/AN, and Hispanic. With regard to mortality, the most common cancer sites differ in that female lung cancer eclipses female breast cancer for white, black, API, and AI/AN populations, but not for Hispanic women. Among Hispanic women, breast cancer mortality is higher than lung cancer mortality. These statistics suggest that greater efforts are needed to address the disparities in cancer burdens among all population subgroups in the U.S.

**TABLE 3**
**Colorectal Cancer Incidence Rates[a,b] by Gender and Race, Selected States and Areas, 1993–1997**

| | Both genders | | | Male | | | Female | | |
|---|---|---|---|---|---|---|---|---|---|
| States and areas | All races | White | Black[b] | All races | White | Black[b] | All races | White | Black[b] |
| Arizona | 36.9 | 37.3 | 37.1 | 43.9 | 44.3 | 43.6 | 31.2 | 31.5 | 31.9 |
| California | 40.5 | 40.4 | 47.8 | 48.4 | 48.2 | 54.5 | 34.2 | 34.1 | 42.5 |
| Greater Bay Area | 39.8 | 38.7 | 49.1 | 49.7 | 49.8 | 54.0 | 35.4 | 36.1 | 38.4 |
| Los Angeles | 41.7 | 42.1 | 45.3 | 48.1 | 47.0 | 55.4 | 33.5 | 32.4 | 44.4 |
| Colorado | 37.4 | 37.3 | 39.5 | 44.2 | 44.2 | 43.4 | 32.0 | 31.9 | 36.1 |
| Connecticut | 48.3 | 48.0 | 51.8 | 58.2 | 57.9 | 65.8 | 40.9 | 40.5 | 43.0 |
| Delaware | 48.2 | 47.6 | 50.6 | 57.9 | 57.6 | 59.2 | 40.7 | 39.7 | 44.5 |
| Florida | 47.8 | 47.5 | 47.7 | 57.0 | 56.8 | 53.6 | 40.5 | 39.9 | 43.3 |
| Georgia: Atlanta Metro | 43.6 | 40.5 | 54.0 | 51.1 | 48.4 | 61.4 | 38.3 | 34.8 | 49.6 |
| Hawaii | 44.5 | 48.9 | | 55.2 | 59.0 | | 35.2 | 38.9 | |
| Idaho | 37.3 | 37.4 | | 44.1 | 44.3 | | 31.6 | 31.6 | |
| Illinois | 46.7 | 45.8 | 52.1 | 55.6 | 54.8 | 60.7 | 40.1 | 39.1 | 46.2 |
| Iowa | 49.6 | 49.6 | 48.6 | 58.5 | 58.5 | 55.3 | 42.6 | 42.6 | 43.9 |
| Kentucky | 45.8 | 45.3 | 54.3 | 54.3 | 53.7 | 66.2 | 39.3 | 38.9 | 45.7 |
| Louisiana | 45.3 | 44.7 | 47.1 | 54.6 | 54.5 | 55.1 | 38.5 | 37.4 | 41.7 |
| Michigan: Detroit Metro | 46.3 | 45.0 | 51.1 | 56.8 | 56.7 | 57.2 | 38.7 | 36.5 | 46.5 |
| Minnesota | 43.2 | 42.9 | 44.2 | 51.0 | 50.5 | 57.7 | 36.9 | 36.7 | 32.9 |
| Montana | 39.6 | 37.4 | | 46.1 | 43.7 | | 34.3 | 32.3 | |
| Nebraska | 45.8 | 45.6 | 45.6 | 55.9 | 55.5 | 52.4 | 38.1 | 37.9 | 41.1 |
| New Hampshire | 48.4 | 47.7 | | 56.7 | 55.9 | | 41.5 | 40.9 | |
| New Jersey | 51.7 | 51.8 | 51.9 | 62.8 | 63.2 | 60.2 | 43.4 | 43.1 | 45.9 |
| New Mexico | 33.5 | 34.1 | 33.0 | 39.7 | 40.4 | 37.6 | 28.2 | 28.8 | 29.9 |
| North Carolina | 38.3 | 37.7 | 41.7 | 45.9 | 46.1 | 45.7 | 32.7 | 31.3 | 39.4 |
| Rhode Island | 51.9 | 52.4 | 47.0 | 62.1 | 62.8 | 54.9 | 44.7 | 45.0 | 41.0 |
| Utah | 32.4 | 32.3 | | 37.8 | 37.8 | | 27.7 | 27.7 | |
| Washington: Seattle-Puget Sound | 41.6 | 41.5 | 49.9 | 49.2 | 49.0 | 64.7 | 35.5 | 35.4 | 37.1 |
| West Virginia | 45.2 | 44.7 | 55.4 | 51.7 | 51.1 | 69.5 | 40.4 | 40.1 | 46.5 |
| Wisconsin | 49.3 | 48.7 | 51.9 | 58.8 | 58.1 | 61.5 | 41.7 | 41.1 | 44.2 |
| SEER program[c] | 42.8 | 42.4 | 49.7 | 51.2 | 50.8 | 57.0 | 36.2 | 35.8 | 44.5 |
| NAACCR combined[a] | 44.2 | 43.8 | 48.5 | 52.7 | 52.4 | 55.8 | 37.5 | 37.1 | 43.3 |

SEER: Surveillance, Epidemiology, and End Results; NAACCR: North American Association of Central Cancer Registries.

[a] Incidence data are for 28 states and areas that meet the North American Association of Central Cancer Registries (NAACCR) standards of highest quality for 1993 to 1997 (Surveillance, Epidemiology, and End Results (SEER) program metropolitan areas within included states are not duplicated in rates). These states/areas cover 49% of the U.S. population. Rates are per 100,000 persons and age-adjusted to the 1970 U.S. standard million population.

[b] Rates are suppressed when incidence rate counts are fewer than 20 in 5-year period.

[c] Includes Greater Bay Area (California), Los Angeles (California), Atlanta Metro (Georgia), Connecticut, Hawaii, Iowa, Detroit Metro (Michigan), New Mexico, Utah, and Seattle-Puget Sound (Washington).

### Colorectal Cancer Occurrence and Screening

Joinpoint analyses of trends in colorectal cancer incidence rates showed increasing rates before the mid-1980s followed by declines among whites and level rates among blacks. Joinpoint analyses of trends in colorectal cancer death rates identified one key change in the long term decline: slightly decreasing rates into the mid-1980s and then an acceleration in the decline. This pattern was confined primarily to whites.

A number of factors could contribute to the observed decrease in the incidence rates. One study suggested that the colorectal cancer incidence rate could be reduced 66–75% through diet and life-style changes in the population.[31] Such changes in diet[32] (e.g., increases in intake of vegetables and other sources of fiber and decreases in red meat intake and alcohol) and increased physical activity[33,34] may play a role in the recent decline in incidence rates. Nondietary factors such as changes in the levels of nonsteroidal anti-inflammatory drugs consumed, including aspirin,[35] also may contribute to the declines. Removal of adenomatous polyps detected through colorectal cancer screening would also reduce the incidence of cancer.[36]

Since the early 1970s, advances have been made in treatment[37] that seemingly would result in a reduced mortality rate. Surgical techniques, including "no-touch" procedures, which were developed during the 1970s and 1980s, lowered morbidity and mortality

**TABLE 4**
**Colorectal Cancer Mortality Rates[a,b] by Gender, Race, and State, 1993–1997**

| | Both genders | | | Male | | | Female | | |
|---|---|---|---|---|---|---|---|---|---|
| State | All races | White | Black[b] | All races | White | Black[b] | All races | White | Black[b] |
| Alabama | 14.9 | 13.8 | 19.8 | 18.2 | 16.9 | 23.9 | 12.7 | 11.6 | 17.1 |
| Alaska | 17.6 | 16.0 | | 20.2 | 19.8 | | 15.2 | 12.5 | |
| Arizona | 14.6 | 14.7 | 19.0 | 17.6 | 17.8 | 21.6 | 12.2 | 12.3 | 17.1 |
| Arkansas | 16.6 | 15.8 | 24.0 | 20.4 | 19.6 | 28.9 | 13.7 | 12.9 | 20.8 |
| California | 15.0 | 15.0 | 21.2 | 18.0 | 18.1 | 24.2 | 12.7 | 12.6 | 18.8 |
| Colorado | 14.4 | 14.4 | 17.9 | 17.2 | 17.2 | 21.1 | 12.2 | 12.2 | 14.8 |
| Connecticut | 16.7 | 16.6 | 18.1 | 20.7 | 20.7 | 22.2 | 13.7 | 13.6 | 15.2 |
| Delaware | 19.0 | 18.1 | 26.3 | 22.8 | 22.2 | 28.3 | 16.0 | 14.9 | 24.4 |
| Washington, DC | 19.9 | 13.2 | 23.2 | 24.1 | 15.1 | 29.1 | 17.1 | 11.7 | 19.5 |
| Florida | 16.1 | 15.8 | 21.4 | 19.5 | 19.2 | 24.2 | 13.4 | 13.0 | 19.4 |
| Georgia | 15.6 | 14.4 | 20.5 | 18.9 | 17.6 | 24.5 | 13.3 | 12.1 | 18.0 |
| Hawaii | 13.7 | 17.0 | | 16.7 | 21.6 | | 11.0 | 12.7 | |
| Idaho | 13.8 | 13.9 | | 17.0 | 17.1 | | 11.4 | 11.4 | |
| Illinois | 18.8 | 18.1 | 25.9 | 23.3 | 22.7 | 31.0 | 15.6 | 14.8 | 22.6 |
| Indiana | 18.5 | 18.0 | 28.0 | 22.3 | 21.8 | 32.4 | 15.7 | 15.1 | 25.1 |
| Iowa | 18.5 | 18.5 | 20.9 | 22.1 | 22.1 | 31.4 | 15.8 | 15.9 | |
| Kansas | 16.2 | 16.1 | 22.7 | 20.0 | 19.7 | 27.3 | 13.4 | 13.3 | 19.4 |
| Kentucky | 19.1 | 18.7 | 25.8 | 23.5 | 23.1 | 31.7 | 15.9 | 15.6 | 21.7 |
| Louisiana | 18.5 | 17.2 | 23.0 | 22.8 | 21.0 | 29.2 | 15.4 | 14.3 | 18.7 |
| Maine | 19.3 | 19.3 | | 22.9 | 22.9 | | 16.7 | 16.8 | |
| Maryland | 19.5 | 18.5 | 25.1 | 24.0 | 23.0 | 30.2 | 16.3 | 15.3 | 21.5 |
| Massachusetts | 19.1 | 19.1 | 22.3 | 23.7 | 23.6 | 27.7 | 15.9 | 15.9 | 18.1 |
| Michigan | 17.3 | 16.6 | 22.9 | 21.5 | 20.9 | 26.5 | 14.2 | 13.4 | 20.3 |
| Minnesota | 15.5 | 15.4 | 19.3 | 19.0 | 18.8 | 29.7 | 12.6 | 12.7 | |
| Mississippi | 16.4 | 14.6 | 21.4 | 20.2 | 18.4 | 25.6 | 13.7 | 11.8 | 18.5 |
| Missouri | 17.9 | 17.3 | 25.2 | 21.8 | 21.2 | 30.9 | 15.0 | 14.5 | 21.3 |
| Montana | 15.9 | 15.8 | | 19.8 | 19.6 | | 12.7 | 12.7 | |
| Nebraska | 18.1 | 18.0 | 24.5 | 23.3 | 23.2 | 33.0 | 14.2 | 14.1 | 19.9 |
| Nevada | 17.1 | 16.9 | 23.0 | 21.0 | 20.9 | 28.2 | 13.7 | 13.4 | 19.3 |
| New Hampshire | 19.3 | 19.3 | | 21.6 | 21.6 | | 17.3 | 17.3 | |
| New Jersey | 20.0 | 19.8 | 23.8 | 24.8 | 24.9 | 28.2 | 16.5 | 16.2 | 20.8 |
| New Mexico | 14.3 | 14.5 | 17.6 | 17.4 | 17.8 | | 11.7 | 11.8 | |
| New York | 18.9 | 19.0 | 19.9 | 23.3 | 23.5 | 24.4 | 15.8 | 15.9 | 17.0 |
| North Carolina | 16.7 | 15.6 | 22.8 | 20.3 | 19.3 | 26.0 | 14.2 | 12.8 | 21.0 |
| North Dakota | 17.4 | 16.9 | | 22.4 | 21.9 | | 13.8 | 13.3 | |
| Ohio | 18.9 | 18.5 | 24.1 | 23.5 | 23.0 | 29.9 | 15.7 | 15.3 | 19.9 |
| Oklahoma | 16.1 | 16.0 | 23.1 | 19.4 | 19.2 | 30.2 | 13.6 | 13.6 | 18.2 |
| Oregon | 15.4 | 15.3 | 19.4 | 18.3 | 18.3 | | 12.9 | 12.9 | |
| Pennsylvania | 19.4 | 19.1 | 24.8 | 23.9 | 23.5 | 31.2 | 16.2 | 15.9 | 20.8 |
| Rhode Island | 19.0 | 19.1 | 24.3 | 24.3 | 24.5 | | 15.5 | 15.4 | 25.6 |
| South Carolina | 17.1 | 15.6 | 22.1 | 21.4 | 19.7 | 27.6 | 14.1 | 12.6 | 18.7 |
| South Dakota | 17.2 | 17.1 | | 20.9 | 21.0 | | 14.3 | 14.2 | |
| Tennessee | 17.4 | 16.2 | 27.1 | 21.2 | 19.9 | 32.6 | 14.7 | 13.5 | 23.6 |
| Texas | 16.1 | 15.4 | 24.6 | 20.1 | 19.4 | 30.5 | 13.0 | 12.3 | 20.4 |
| Utah | 12.3 | 12.2 | | 14.1 | 14.0 | | 10.8 | 10.8 | |
| Vermont | 18.4 | 18.5 | | 21.4 | 21.5 | | 16.2 | 16.2 | |
| Virginia | 17.3 | 16.0 | 24.9 | 20.8 | 19.4 | 29.6 | 14.8 | 13.7 | 21.6 |
| Washington | 15.2 | 15.2 | 21.7 | 18.1 | 18.0 | 31.3 | 12.9 | 13.0 | 13.4 |
| West Virginia | 18.4 | 18.2 | 28.0 | 21.8 | 21.6 | 33.0 | 15.9 | 15.6 | 24.3 |
| Wisconsin | 16.6 | 16.5 | 18.3 | 20.6 | 20.5 | 22.2 | 13.6 | 13.5 | 15.4 |
| Wyoming | 16.5 | 16.4 | | 18.1 | 18.1 | | 15.2 | 15.1 | |
| U.S. | 17.2 | 16.8 | 22.8 | 21.0 | 20.6 | 27.5 | 14.4 | 13.9 | 19.7 |

[a] Death data are from National Center for Health Statistics (NCHS) covering the entire U.S. population. Rates are per 100,000 persons and are age-adjusted to the 1970 U.S. standard million population.
[b] Rates are suppressed when death counts are fewer than 20 in 5-year period.

**TABLE 5**
**U.S. Prevalence[a] of Fecal Occult Blood Tests and Sigmoidoscopy/Proctoscopy among Adults Age ≥ 50 Years by Selected Characteristics, 1997**

| | Fecal occult blood test during preceding year | | | Sigmoidoscopy/proctoscopy during preceding 5 years | | |
|---|---|---|---|---|---|---|
| | Total % (SE) | Male % (SE) | Female % (SE) | Total % (SE) | Male % (SE) | Female % (SE) |
| | 19.8 (0.3) | 18.4 (0.4) | 21.0 (0.4) | 30.6 (0.3) | 35.2 (0.5) | 26.8 (0.4) |
| Race | | | | | | |
| White | 20.1 (0.3) | 18.8 (0.5) | 21.2 (0.4) | 31.0 (0.3) | 35.7 (0.6) | 27.3 (0.4) |
| Black | 20.5 (1.1) | 18.4 (1.8) | 21.9 (1.4) | 29.9 (1.2) | 34.8 (2.1) | 26.5 (1.4) |
| API | 11.5 (1.9) | 7.4 (1.8) | 14.8 (3.1) | 25.9 (3.6) | 36.0 (5.9) | 18.3 (4.2) |
| AI/AN | 12.1 (2.2) | 14.7 (3.8) | 9.5 (2.2) | 24.2 (3.4) | 28.8 (5.0) | 19.5 (4.7) |
| Ethnicity | | | | | | |
| Hispanic | 11.8 (1.2) | 10.3 (1.7) | 13.0 (1.6) | 26.8 (1.8) | 28.8 (2.9) | 25.0 (2.2) |
| Non-Hispanic | 20.3 (0.3) | 18.8 (0.4) | 21.4 (0.4) | 30.8 (0.3) | 35.6 (0.5) | 26.9 (0.4) |
| Age (yrs) | | | | | | |
| 50–59 | 15.6 (0.4) | 13.9 (0.6) | 17.1 (0.6) | 23.8 (0.5) | 27.4 (0.8) | 20.5 (0.6) |
| 60–69 | 21.9 (0.5) | 20.1 (0.8) | 23.4 (0.7) | 33.3 (0.6) | 39.4 (1.0) | 28.2 (0.7) |
| 70–79 | 23.7 (0.6) | 23.3 (1.0) | 23.9 (0.7) | 37.1 (0.7) | 43.2 (1.1) | 32.9 (0.8) |
| 80–84 | 22.8 (1.3) | 24.1 (2.3) | 22.0 (1.5) | 32.6 (1.4) | 37.2 (2.5) | 29.9 (1.6) |
| 85+ | 16.7 (1.2) | 17.3 (2.3) | 16.4 (1.3) | 30.5 (1.5) | 36.6 (2.9) | 27.6 (1.7) |

SE: standard error; API: Asian/Pacific Islander; AI/AN: American Indian/Alaska Native.
[a] Prevalence estimates are from the Centers for Disease Control and Prevention Behavioral Risk Factor Surveillance System. Estimates do not include Puerto Rico.

for abdominoperineal resection. After a 1990 consensus conference, adjuvant chemotherapy (5-fluorouracil and levamisole) became more widely used (Harlan L, personal communication). Colorectal cancer screening also contributes to the decline in mortality by detecting the disease at an earlier stage.

The incidence and mortality rates for colorectal cancer varied somewhat across states. Composite colorectal cancer incidence rates from SEER and NAACCR were similar. In comparing rates across different geographic areas, it is important to consider possible underlying reasons for the observed variations. Differences among the state rates may be attributable to factors such as demographic characteristics, risk factor prevalence, and variations in cancer registration operations (e.g., case ascertainment, resolution of duplicate reports of cases, and identification of multiple primary cancers). The demographic characteristics could include age, urbanization, race, and ethnicity. Risk factors may include diet,[32] aspirin use,[35] physical activity,[33,34] genetic factors,[38,39] and hormone replacement therapy in women.[40] A recent study examined U.S. geographic variations in colorectal cancer incidence rates for the period 1991–1995 for such factors as screening penetration, race, urbanization, data quality of cancer registration operations, and unadjusted variation in population age structures.[41] Among the 36 states and areas, including those in the SEER program, analyses of the percent of the population age ≥ 50 years that also were age 65 years and older explained 12% of the variance in colorectal cancer incidence rates in men and 26% of this variance in women. Thus, although the rates used in comparative analyses are age-adjusted, this adjustment does not control for the variation of the age distribution within the oldest age groups (i.e., the population age ≥ 85 years). States or areas with a greater proportion of older persons within the oldest age groups would be expected to have a higher incidence rate based on age alone unless the finding is spurious and caused by an unknown factor associated both with the colorectal cancer incidence rate and age-adjustment.

The extent to which screening programs are adopted by the population or to which community physicians apply state-of-the-art treatment protocols also influences incidence, survival, and mortality. The 1997 BRFSS findings suggest that screening for colorectal cancer varied by state and was fairly low. Certainly, when comparing mortality by geographic area and population, state-to-state variations in the availability and accessibility of standard cancer treatments must be considered, especially in light of differences in the utilization of specific cancer treatments by age, race, and geographic area.[42-47] New research is needed to further our understanding of these differences.

Colorectal cancer incidence and death rates among black men and women were higher than among persons of other racial and ethnic groups. Moreover, the disparity between blacks and whites in

**TABLE 6**
**U.S. Prevalence[a,b] of Fecal Occult Blood Tests and Sigmoidoscopy/Proctoscopy among Adults Age ≥ 50 Years by State, Gender, and Race, 1997**

| | Fecal occult blood test during preceding year | | | | | Sigmoidoscopy/proctoscopy during preceding 5 years | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| State | Total (%) | Male (%) | Female (%) | White (%) | Black[b] (%) | Total (%) | Male (%) | Female (%) | White (%) | Black[b] (%) |
| Alabama | 14.3 | 15.2 | 13.6 | 13.2 | 18.6 | 29.6 | 35.9 | 24.9 | 28.1 | 36.4 |
| Alaska | 15.4 | 14.8 | 16.1 | 15.6 | | 33.0 | 35.4 | 30.5 | 34.1 | |
| Arizona | 16.9 | 19.7 | 14.6 | 16.3 | | 31.3 | 35.4 | 28.1 | 32.1 | |
| Arkansas | 13.4 | 13.9 | 12.9 | 14.5 | | 22.9 | 25.6 | 20.8 | 24.6 | |
| California | 16.4 | 13.3 | 19.0 | 17.7 | | 35.4 | 40.1 | 31.7 | 37.5 | |
| Colorado | 24.0 | 25.0 | 23.1 | 23.5 | | 30.7 | 34.2 | 27.7 | 31.4 | |
| Connecticut | 24.2 | 21.8 | 26.1 | 24.6 | | 35.1 | 37.9 | 32.8 | 36.1 | |
| Delaware | 22.5 | 24.1 | 21.2 | 23.1 | 20.7 | 37.1 | 42.9 | 32.3 | 38.1 | 29.8 |
| DC | 25.6 | 24.6 | 26.4 | 30.3 | 23.3 | 41.5 | 44.8 | 39.1 | 47.7 | 38.6 |
| Florida | 24.0 | 22.2 | 25.4 | 24.9 | | 28.6 | 32.1 | 25.8 | 29.1 | 21.8 |
| Georgia | 14.8 | 14.1 | 15.3 | 15.7 | | 38.5 | 43.7 | 34.4 | 39.5 | 36.4 |
| Hawaii | 21.6 | 18.4 | 24.7 | 18.3 | | 39.7 | 45.9 | 34.1 | 37.7 | |
| Idaho | 17.6 | 14.4 | 20.3 | 17.9 | | 26.1 | 29.7 | 23.1 | 25.9 | |
| Illinois | 14.4 | 14.4 | 14.4 | 13.3 | | 29.2 | 35.4 | 24.7 | 30.2 | |
| Indiana | 16.0 | 14.0 | 17.7 | 16.0 | | 23.9 | 28.7 | 20.1 | 23.7 | |
| Iowa | 18.6 | 17.4 | 19.5 | 18.3 | | 27.9 | 33.3 | 23.8 | 28.1 | |
| Kansas | 23.0 | 22.4 | 23.4 | 22.6 | | 29.9 | 35.4 | 25.3 | 29.2 | |
| Kentucky | 18.2 | 15.4 | 20.4 | 17.6 | 28.2 | 25.3 | 29.5 | 22.0 | 25.1 | 28.3 |
| Louisiana | 16.9 | 16.1 | 17.5 | 16.3 | 21.9 | 26.2 | 29.0 | 24.1 | 25.4 | 28.7 |
| Maine | 28.4 | 25.3 | 31.0 | 28.4 | | 32.0 | 33.8 | 30.6 | 31.9 | |
| Maryland | 25.1 | 24.6 | 25.5 | 25.1 | 24.4 | 25.8 | 34.2 | 18.9 | 23.9 | 33.9 |
| Massachusetts | 28.1 | 21.2 | 33.7 | 28.7 | | 31.0 | 40.7 | 23.3 | 32.0 | |
| Michigan | 22.4 | 19.6 | 24.7 | 23.1 | | 34.6 | 36.8 | 32.7 | 35.2 | 31.4 |
| Minnesota | 21.9 | 20.7 | 22.9 | 22.2 | | 39.7 | 44.9 | 35.2 | 39.9 | |
| Mississippi | 9.2 | 6.1 | 11.7 | 9.0 | | 25.7 | 25.6 | 25.8 | 26.4 | 24.8 |
| Missouri | 17.2 | 15.2 | 18.7 | 17.1 | | 29.6 | 32.2 | 27.7 | 30.3 | |
| Montana | 16.6 | 13.0 | 19.7 | 16.7 | | 25.4 | 26.0 | 24.9 | 25.1 | |
| Nebraska | 17.8 | 15.8 | 19.5 | 17.8 | | 24.1 | 29.3 | 19.8 | 24.3 | |
| Nevada | 10.7 | 13.6 | 8.1 | 11.4 | | 29.1 | 39.4 | 20.1 | 28.7 | |
| New Hampshire | 26.8 | 23.0 | 30.0 | 26.6 | | 33.4 | 41.1 | 26.8 | 33.3 | |
| New Jersey | 21.7 | 21.5 | 21.8 | 21.9 | | 29.6 | 37.8 | 23.3 | 31.6 | |
| New Mexico | 15.0 | 12.4 | 17.2 | 15.5 | | 27.0 | 33.7 | 21.4 | 28.3 | |
| New York | 24.8 | 25.3 | 24.4 | 23.0 | 42.0 | 31.7 | 38.8 | 26.4 | 31.2 | 37.4 |
| North Carolina | 27.2 | 23.1 | 30.6 | 28.4 | 21.2 | 30.8 | 34.4 | 28.0 | 30.2 | 35.9 |
| North Dakota | 14.7 | 10.8 | 18.1 | 14.3 | | 30.2 | 33.6 | 27.3 | 30.3 | |
| Ohio | 18.4 | 18.2 | 18.6 | 18.6 | 16.8 | 30.1 | 36.9 | 24.7 | 30.4 | 27.7 |
| Oklahoma | 10.9 | 9.2 | 12.2 | 10.8 | | 15.5 | 13.8 | 17.0 | 15.7 | |
| Oregon | 23.9 | 20.0 | 27.1 | 24.0 | | 30.8 | 35.1 | 27.2 | 30.7 | |
| Pennsylvania | 22.0 | 21.2 | 22.6 | 22.0 | | 31.9 | 38.5 | 27.0 | 31.7 | 37.0 |
| Puerto Rico | 16.1 | 14.4 | 17.4 | 15.6 | | 20.5 | 26.5 | 15.8 | 20.9 | |
| Rhode Island | 21.1 | 18.3 | 23.3 | 21.4 | | 32.7 | 37.3 | 29.2 | 33.2 | |
| South Carolina | 15.5 | 13.5 | 17.0 | 16.9 | | 21.2 | 25.0 | 18.2 | 22.1 | 18.5 |
| South Dakota | 15.0 | 13.6 | 16.1 | 15.1 | | 27.9 | 34.5 | 22.6 | 27.8 | |
| Tennessee | 15.9 | 12.7 | 18.5 | 16.5 | | 26.5 | 26.9 | 26.1 | 26.8 | 23.1 |
| Texas | 19.6 | 20.6 | 18.7 | 21.2 | | 27.5 | 29.9 | 25.4 | 28.9 | |
| Utah | 14.7 | 14.1 | 15.3 | 14.9 | | 30.2 | 38.0 | 23.6 | 30.4 | |
| Vermont | 26.6 | 25.1 | 27.7 | 26.7 | | 28.5 | 33.1 | 24.7 | 28.8 | |
| Virginia | 19.8 | 18.2 | 21.2 | 19.9 | 18.9 | 33.5 | 37.2 | 30.5 | 34.1 | 31.1 |
| Washington | 24.4 | 19.7 | 28.5 | 24.4 | | 31.1 | 35.0 | 27.8 | 31.3 | |
| West Virginia | 11.9 | 11.4 | 12.3 | 11.9 | | 24.8 | 28.0 | 22.2 | 24.4 | |
| Wisconsin | 17.2 | 15.5 | 18.6 | 17.8 | | 34.3 | 38.7 | 30.7 | 34.8 | |
| Wyoming | 14.3 | 12.5 | 15.9 | 14.7 | | 30.0 | 32.6 | 27.8 | 29.6 | |
| United States[c] | 19.8 | 18.4 | 21.0 | 20.1 | 20.5 | 30.5 | 35.2 | 26.8 | 31.0 | 29.9 |

DC: District of Columbia.

[a] Prevalence estimates are from the Centers for Disease Control and Prevention Behavioral Risk Factor Surveillance System.

[b] Percentages are suppressed when numerator or denominator counts are fewer than 20.

[c] Estimates do not include Puerto Rico.

colorectal cancer death rates may be increasing. In the 1970s and early 1980s, the differences in female colorectal cancer rates between blacks and whites were small; in the 1990s, the racial trends among women increasingly diverged. Among men, the pattern of trends in rates was similar although the rates were more variable.

For the 1990s, comparisons of trends in colorectal cancer rates across the five racial and ethnic groups were complicated by large year-to-year variations. Except for the white population, colorectal cancer incidence and mortality rates for men in these populations showed greater variation than for women. The decreasing trends in incidence rates for black and white men in the 1990s appeared stronger than those for men of other races or ethnicity. Similarly, the downward trends in incidence rates for black and white women appeared greater than for API and Hispanic women, with the trend among AI/AN women having the largest annual fluctuations.

Cancer rates vary considerably among AI[48] and AN populations.[49] Colon cancer incidence rates in AN men and women have increased significantly since the early 1970s, and cancer of the colon/rectum was the most frequently diagnosed malignancy in this population between 1989–1993, which is approximately 1.5 times higher than overall SEER incidence rates between 1989–1992.[50] Reasons for the higher rates of colorectal cancer incidence among ANs are unclear.

The decline in colorectal cancer mortality in the 1990s was evident among men of all racial groups except among AI/AN, in whom the annual fluctuation in rates made the interpretation of trends less clear. Although these recent trends are encouraging, continued improvement for all racial/ethnic groups is needed.

### Limitations of Cancer Occurrence and Screening Data

It is difficult to use one summary statistic to describe long-term cancer trends. Therefore, two approaches were used to study trends. First, incidence and mortality trends were compared by site and gender for the same recent time period (1990–1997). In addition, the new joinpoint method provided a more detailed description of the cancer pattern over the 25-year period. For many malignancies, incidence and death rates have shown recent declines after increasing during earlier time periods.

For the first type of analyses, the APC statistic was used to describe short-term trends in the 1990s. The underlying assumption was that the rates increased or decreased at a constant rate over the time interval (1990–1997). Trends based on 1990–1997 data may be compared across cancer sites, genders, racial and ethnic populations, and other groups as necessary. For the second type of analysis, the joinpoint method allowed more flexible, and perhaps more accurate, analyses so that the year(s) are identified in which significant changes in the trends occurred. This method was adopted to describe better the cancer patterns over long periods of time in contrast to identifying only one trend statistic as was done in previous reports. The joinpoint analysis for each site, race, and gender showed different cancer incidence and death patterns. Because the rates for blacks are based on fewer cases than those for whites, the rates for blacks have more variation. Thus, the joinpoint analysis may not be as able to discern changes in trends among blacks compared with whites. For example, the colorectal cancer incidence rates for black men appear as though they may have begun to decline. However, the joinpoint analysis cannot detect this as yet due to the variability in the rates for black men (Fig. 7). If the trends are not linear, the APC will lack statistical significance. In addition, some random variation exists in rates across the years. Although the joinpoint analysis provides a precise description of trends for persons of a particular race and gender, comparisons across different races and genders may be more difficult because each may have a different number of joinpoints and may have different years of inflection.

Assessments of the absolute and comparative levels of cancer incidence and death rates by race and ethnicity need to be tempered by the recognition of potential biases in the data. The biases may result from misreporting race and ethnicity and, to a lesser extent, age on the basic records from which information is collected with regard to cancer incidence death, and the population at risk.[51-55] Rates may be biased because of misreporting on death certificates (NCHS)[51–53] and hospital medical records,[54] which comprise the numerators of the cancer death and incidence rates, respectively, and on censuses and surveys, which comprise the denominators of the rates. Recent evaluation studies suggest that the reporting of race for the white and black populations generally is reliable, and that biases are more serious for some of the smaller populations, particularly for American Indians.[52,54] Although these biases affect comparisons among groups at a specified point in time, the trend data for both incidence and death rates are considered to be relatively reliable.

Survival rates have several limitations. First, although they provide some indication of the average survival experience of cancer patients in the U.S., they are less useful in predicting survival for individual cancer patients. Second, they are based on cases that were diagnosed as many as 8 years previously and

therefore cannot reflect the most recent advances in screening and treatment.[56]

The receipt of cancer screening tests is self-reported by NHIS and BRFSS survey respondents and not validated; in addition, the two surveys have different response rates and use different wording for the questions.[57] One limitation of these data is that respondents may not comprehend fully the descriptions of medical procedures from a survey question, may not remember receiving a screening procedure, or may not accurately estimate how much time has elapsed from the receipt of the procedure to the time of the survey. Efforts have been made in recent years to improve the detail, validity, and comprehensibility of NHIS questions regarding colorectal cancer screening procedures. The BRFSS is subject to the additional limitation that it is a telephone survey, and only persons with a telephone were represented. However, 95% of Americans now have telephones although this varies by population group.[57] The BRFSS questionnaire also did not distinguish between tests conducted for screening as opposed to those conducted for diagnostic purposes. Therefore, the actual prevalence of these tests for screening purposes most likely is lower than reported by the BRFSS.

### Strategies for the Future

Colorectal cancer screening was not responsible for the early declines in colorectal cancer death rates because colorectal cancer death rates, especially for females, have been declining since the 1950s, which was prior to the publication of screening guidelines. However, screening may have played a role in the more recent, steeper declines in colorectal cancer incidence and death rates and has the potential for increased benefits in the future. The U.S. Preventive Services Task Force,[58] the American Cancer Society,[59] and the Interdisciplinary Task Force[60] have established new screening guidelines for colorectal screening. These guidelines, published in the mid-1990s, emphasize the benefits of early detection and treatment of precancerous polyps and cancer through the use of FOBT, sigmoidoscopy, colonoscopy, and barium enema.

Despite the guidelines, NHIS and BRFSS show low levels of FOBT and sigmoidoscopy/proctoscopy within the recommended time periods. However, the NHIS survey shows small increases in prevalence from 1987–1998. For screening to be effective in reducing morbidity and mortality from colorectal cancer, it must be performed on a regular basis (i.e., in compliance with recommended guidelines); however, the prevalence of repeat screening has been reported to be low for both FOBT and sigmoidoscopy.[61] Recent reviews of the literature regarding patient and provider adherence to colorectal cancer screening guidelines point to the need to address barriers.[61,62] Surveys of patients showed that for both FOBT and sigmoidoscopy, practical concerns (e.g., conflicts with work or family, inconvenience, being too busy, cost) and not currently having symptoms or health problems were the most important reasons for not taking an opportunity to be screened.[61] Provider barriers to offering FOBT included forgetfulness, perceived ineffectiveness, cost, and inconvenience to patients.[62] Reasons providers gave for not offering sigmoidoscopy included patient discomfort, provider inconvenience, lack of time, low probability of finding a lesion, lack of experience or training in sigmoidoscopy, and cost. Based on our knowledge, interventions to increase patient and provider adoption of colorectal cancer screening have met with only modest success.[61,62] There are a number of ongoing NCI-funded studies of behavioral interventions to increase rates of colorectal cancer screening in both patient and providers. The ACS, NCI, and CDC are in the process of conducting national provider and patient surveys regarding colorectal screening practices in health care organizations. One survey currently is being administered to primary care physicians, specialists and patients to assess their knowledge, attitudes, and practices related to colorectal screening.[63] Another survey is directed toward health plan medical directors with a focus on coverage policies, guidelines, and programs for colorectal cancer screening. Data from these studies should be useful in developing and refining strategies to overcome patient and provider barriers.

Public education efforts currently are being directed toward increasing awareness of the benefits of colorectal cancer screening. Activities include the National Colorectal Cancer Roundtable, established by the CDC and ACS to strengthen the network of private and public organizations, including the NCI, promoting colorectal cancer screening. In March 1999, a national education campaign called "Screen for Life: National Colorectal Cancer Action Campaign" (available at URL: www.cdc.gov/cancer/ScreenForLife) was launched to inform men and women age $\geq$ 50 years about the importance of colorectal cancer screening for early detection and prevention. The CDC has spearheaded this effort in collaboration with the Health Care Finance Administration (HCFA) and the NCI. The CDC and NCI also are working with the HCFA to promote Medicare's new coverage for colorectal cancer screening. In the U.S., March has been established as "National Colorectal Cancer Awareness

Month" to focus more attention and efforts toward the prevention and early detection of colorectal cancer.

Cancer incidence and death rates were reported separately for white, black, API, AI/AN, and Hispanic populations. These broad groupings of race and ethnicity for cancer incidence and death rates may be obscuring important differences in more specific populations such as Chinese-Americans and Japanese-Americans, [64] Hispanics from different nationalities and cultures,[65] rural populations, populations of low socioeconomic status or low educational levels,[66] or those with limited access to medical care. Methods to study incidence and death rates by urban-rural designation and socioeconomic indicators at the individual and social-structural level currently are in progress. If determined to be reliable and meaningful, they can be applied to the data regarding U.S. cancer incidence and mortality.

Measuring the occurrence of cancer by race/ethnicity and other sociodemographic characteristics serves to identify subgroups of the population who are at increased or decreased risk. To our knowledge, data concerning adherence to colorectal cancer screening, diagnostic evaluation, and treatment modalities by race/ethnicity and other demographic factors are sparse, but the literature suggests other areas of cancer prevention and control in which special efforts will be needed to ensure the participation of medically underserved populations in the continuum of care for colorectal cancer. Developing strategies to encourage the adoption of effective prevention, screening, diagnostic evaluation, and treatment modalities, requires understanding cultural differences in literacy, language, world view, beliefs, values, social norms, help-seeking behaviors, and attitudes toward and access to medical care. Cultural factors and other important determinants must be incorporated into interventions, and ultimately into standard medical practice, so that the benefits of state-of-the-art knowledge and practice will be realized by all.

In the future, expanded study of special populations such as AI/AN, Hispanics of different national origins, populations in the southeastern U.S., Appalachia, rural America, and other geographic locations should be possible as the number of population-based cancer registries, with high quality cancer incidence data, increases as a result of the expansion of the SEER program and renewal of the CDC's National Program of Cancer Registries (NPCR). The NAACCR has established criteria and standards to assess the quality of registry data. These should be expanded to include an evaluation of the accuracy and reliability of case counts and population data for racial and ethnic groups other than blacks and whites before these data can be utilized fully. To begin this, several NAACCR workgroups have been formed to address the quality of the race/ethnic data with the initial focus in 2000 on the reliability of identifying AI/AN, API, and Hispanic populations across all U.S. registries.

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