Breast Cancer Statistics, 2015: Convergence of Incidence Rates Between Black and White Women

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In this article, the American Cancer Society provides an overview of female breast cancer statistics in the United States, including data on incidence, mortality, survival, and screening. Approximately 231,840 new cases of invasive breast cancer and 40,290 breast cancer deaths are expected to occur among US women in 2015. Breast cancer incidence rates increased among non-Hispanic black (black) and Asian/Pacific Islander women and were stable among non-Hispanic white (white), Hispanic, and American Indian/Alaska Native women from 2008 to 2012. Although white women have historically had higher incidence rates than black women, in 2012, the rates converged. Notably, during 2008 through 2012, incidence rates were significantly higher in black women compared with white women in 7 states, primarily located in the South. From 1989 to 2012, breast cancer death rates decreased by 36%, which translates to 249,000 breast cancer deaths averted in the United States over this period. This decrease in death rates was evident in all racial/ethnic groups except American Indians/Alaska Natives. However, the mortality disparity between black and white women nationwide has continued to widen; and, by 2012, death rates were 42% higher in black women than in white women. During 2003 through 2012, breast cancer death rates declined for white women in all 50 states; but, for black women, declines occurred in 27 of 30 states that had sufficient data to analyze trends. In 3 states (Mississippi, Oklahoma, and Wisconsin), breast cancer death rates in black women were stable during 2003 through 2012. Widening racial disparities in breast cancer mortality are likely to continue, at least in the short term, in view of the increasing trends in breast cancer incidence rates in black women. CA Cancer J Clin 2016;66:31-42. © 2015 American Cancer Society.

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Introduction
Excluding skin cancers, breast cancer is the most common cancer diagnosed among US women, accounting for nearly one in three cancers. It is also the second leading cause of cancer death among women after lung cancer. In this article, we describe trends in breast cancer incidence, mortality, survival, and screening by race/ethnicity in the United States as well as state variations in these measures. Additional data are available from the biennial publication of Breast Cancer Facts & Figures (available at cancer.org/statistics).

Materials and Methods
Data Sources
Data on incidence trends, probabilities of developing cancer, and cause-specific survival were obtained from the Surveillance, Epidemiology, and End Results (SEER) program of the National Cancer Institute.1-4 The SEER program has been collecting clinical, pathological, and demographic information on cancer patients since 1973. Data are available for whites, blacks, and all races combined since 1973 and for American Indian/Alaska Natives (AI/ANs), Asian/Pacific Islanders (APIs), and Hispanics since 1992. SEER incidence rates were adjusted for reporting delay. Incidence rates by race/ethnicity, stage at diagnosis, and the distribution of breast cancer cases by hormone receptor (HR) and human epidermal growth factor receptor 2 (HER2) statuses were obtained using 2008 through 2012 data from the North American Association of Central Cancer Registries (NAACCR).5 NAACCR data were also used for state-level analyses of breast cancer incidence rates and proportions of breast cancers.
diagnosed at in situ and regional/distant stages. Overall US rates based on data from NAACCR include all states except Arkansas, Minnesota, and Nevada, because these states failed to meet NAACCR high-quality standards for 1 or more years during 2008 through 2012. For analyses by HR and HER2 status, we limited our analyses to cases diagnosed during 2012, because HER2 status was not required by registries until 2010 and has become increasingly complete since that time. Thus, we excluded 15 additional states (Alabama, Arizona, Florida, Kansas, Louisiana, Maryland, New Jersey, New Mexico, New York, Oklahoma, South Carolina, Tennessee, Texas, West Virginia, and Wyoming) and Washington, DC because greater than 10% of cases were missing HER2 status.

Mortality data were obtained from the SEER program's SEER*Stat database as provided by the National Center for Health Statistics. Data beginning in 1969 are available for whites and blacks. Since 1990, data are available for the 5 major racial and ethnic groups: non-Hispanic whites, non-Hispanic blacks, APIs, AI/ANs, and Hispanics. Population data were obtained from the US Census Bureau.

Prevalence data on mammography by race/ethnicity and state were obtained from the 2012 Behavioral Risk Factor Surveillance System, an ongoing system of surveys conducted by the state health departments in cooperation with the Centers for Disease Control and Prevention. Mammo gram prevalence estimates do not distinguish between examinations for screening and diagnosis.

Statistical Analyses
Estimates of the total number of invasive and in situ breast cancer cases and breast cancer deaths for 2015 were published previously. We calculated the estimated number of breast cancer cases by age at diagnosis by applying the proportion of cases diagnosed in each age group during 2008 through 2012 from the NAACCR analytic file to the total number of estimated cases of invasive and in situ breast cancer in 2015. Similarly, we calculated the estimated number of breast cancer deaths by age at death by applying the proportion of deaths that occurred in each age group during 2008 through 2012 to the total estimated breast cancer deaths in 2015.

The estimated number of female breast cancer deaths averted because of the reduction in breast cancer death rates was calculated by first estimating the number of cancer deaths that would have occurred if the death rate had remained at its 1989 level. The expected number of deaths was estimated by applying the 5-year age-specific cancer death rates in 1989 to the corresponding age-specific female populations from 1990 through 2012. The total number of breast cancer deaths averted was the sum of the difference between the expected number and recorded number of cancer deaths in each age group and calendar year.

We examined incidence trends by race/ethnicity, age, and stage and mortality trends by state using the National Cancer Institute’s Joinpoint regression analysis program (version 4.2.0.2). The direction and magnitude of the resulting trends are described by the annual percent change (APC). In describing trends, the terms increase or decrease were used when the APC was statistically significant; otherwise the term stable was used. The relation between state-level mammography screening rates in 2012 and the percentage of breast cancer cases diagnosed at in situ and late stages during 2008 through 2012 was examined by using the Pearson correlation coefficient. We also calculated rate ratios to compare the incidence rates between black women and white women by state. Probabilities of developing breast cancer were calculated using the DevCan (version 6.7.3) probability of developing cancer software program developed by the National Cancer Institute.

SELECTED FINDINGS
Expected Numbers of New Cases and Deaths by Age
Table 1 shows the estimated number of female breast cancer cases and deaths that are expected to occur in the United States.

### TABLE 1. Estimated New Female Breast Cancer Cases and Deaths by Age, United States, 2015

| AGES | IN SITU CASES | INVASIVE CASES | DEATHS |
|------|--------------|----------------|--------|
|      | NUMBER %     | NUMBER %       | NUMBER % |
| <40  | 1,650 3%     | 10,500 5%      | 1,010 3% |
| 40-49| 12,310 20%   | 35,850 15%     | 3,690 9% |
| 50-59| 16,970 28%   | 54,060 23%     | 7,600 19% |
| 60-69| 15,850 26%   | 59,990 26%     | 9,090 23% |
| 70-79| 9,650 16%    | 42,480 18%     | 8,040 20% |
| 80+  | 3,860 6%     | 28,960 12%     | 10,860 27% |
| All  | 60,290       | 231,840        | 40,290 |

*Rounded to the nearest 10 cases. Percentages may not sum to 100% due to rounding.

### TABLE 2. Age-Specific Probabilities of Developing Invasive Female Breast Cancer in the United States

| IF CURRENT AGE IS... | THE PROBABILITY OF DEVELOPING BREAST CANCER IN THE NEXT 10 YEARS IS: OR 1 IN: |
|----------------------|--------------------------------------------------------------------------------|
| 20                   | 0.06% 1,674                                                                  |
| 30                   | 0.44% 225                                                                   |
| 40                   | 1.44% 69                                                                    |
| 50                   | 2.28% 44                                                                    |
| 60                   | 3.46% 29                                                                    |
| 70                   | 3.89% 26                                                                    |
| Lifetime risk        | 12.32% 8                                                                     |

*Among those free of cancer at beginning of age interval. Based on cases diagnosed 2010-2012. Percentages and “1 in” numbers may not be numerically equivalent due to rounding.

Probabilities derived using NCI DevCan Software, Version 6.7.3.
United States in 2015 by age. Approximately 231,840 new cases of invasive breast cancer and 40,290 deaths are expected among US women in 2015. In addition to invasive breast cancers, about 60,290 new diagnoses of in situ breast cancer are expected among US women in 2015. The median age at diagnosis for female breast cancer is 61 years.4 The median age at diagnosis is younger for black women (58 years) than for white women (62 years). The median age at breast cancer death is 68 years overall: 69 years for white women and 62 years for black women.4

Probability of Developing Invasive Female Breast Cancer

About 12% of women in the US (or 1 in 8) will be diagnosed with breast cancer in their lifetime (Table 2). This lifetime risk represents an average of the risks of different women, rather than the risk of any one woman. Lifetime risk includes the possibility that women will die from other causes before being diagnosed with breast cancer and is often misinterpreted to apply only to women who live to very old ages. Age-specific probabilities for developing cancer over a 10-year period are also provided in Table 2. For example, the risk for a cancer-free woman aged 40 years of being diagnosed with breast cancer over the next 10 years is 1.4%. Equivalently, 1 in 69 women who are aged 40 years will be diagnosed with breast cancer by the age of 50 years.

Cancer Occurrence in the Most Recent Time Period (2008-2012)

Incidence and mortality rates

Female breast cancer incidence and mortality rates vary substantially by race/ethnicity (Fig. 1). Non-Hispanic white (white) and non-Hispanic black (black) women have higher breast cancer incidence and death rates than women of other race/ethnicities; API women have the lowest incidence and death rates. Although the overall breast cancer incidence rate is slightly lower in black women than in white women, the breast cancer death rate is 42% higher in blacks than in whites. This mortality difference likely reflects a combination of biologic and nonbiologic factors, including differences in stage at diagnosis, obesity and comorbidities, tumor characteristics, as well as access, adherence, and response to treatments.13–16 Lower breast cancer rates in AI/AN, Hispanic, and API women are thought to largely reflect variation in the prevalence of breast cancer risk factors.17 For example, Hispanic women tend to have a greater number of children and AI/AN women have their first child at younger ages compared to women of other race/ethnicities, both of which are protective against breast cancer.18 Conversely, API women are more likely to breastfeed for at least 12 months, less likely to consume alcohol, and have lower rates of obesity, which are generally associated with lower breast cancer risk.19–21

Distribution of breast cancer subtypes

Although often referred to as a single disease, breast cancer is distinguished by up to 21 distinct histologic subtypes and at least 4 different molecular subtypes, which
are associated with distinct risk factors and are biologically variable in presentation, response to treatment, and outcomes.\textsuperscript{22–27} Gene expression profiling techniques have allowed researchers to better understand the genetic variability among tumors; however, use of these techniques is currently not standard clinical practice. More convenient approximations of molecular subtypes have been identified using routinely evaluated biological markers, including the presence or absence of hormone (estrogen or progesterone) receptors (HR-positive/HR-negative [HR+/HR−]) and overexpression of the HER2 (HER2+/HER2−) protein.\textsuperscript{28,29} The clinical approximations of molecular subtypes appear to be better for some subtypes than for others.\textsuperscript{30}

Figure 2 shows the distribution of US breast cancer cases by subtype (as defined by HR and HER2 statuses) and race/ethnicity in 2012. Overall, 74% of breast cancer cases were HR+/HER2− (luminal A), 12% were HR−/HER2− (triple negative), 10% were HR+/HER2+ (luminal B), and 4% were HR−/HER2+ (HER2-enriched), with the distributions varying substantially by race/ethnicity. Black women have the smallest proportion of HR+/HER2− breast cancers and the largest proportion of HR−/HER2− breast cancers compared with women of other race/ethnicities. Triple-negative breast cancers are considered to be more aggressive and have poorer prognoses, in part because there are currently no targeted therapies for these tumors.\textsuperscript{31,32} In contrast, white women have the highest proportion of HR+/HER2− breast cancers, whereas API women have the largest proportion of HR−/HER2+ breast cancers. HR+/HER2− (luminal A) breast cancers are associated with higher survival rates, particularly in the first 5 years after diagnosis, in part because expression of HRs is predictive of response to hormonal therapy.\textsuperscript{28,31}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure3.png}
\caption{Breast Cancer Stage Distribution and 5-Year Cause-Specific Survival by Race/Ethnicity.}
\end{figure}

\textsuperscript{34} CA: A Cancer Journal for Clinicians
Stage distribution and survival

Distribution of breast cancer cases by stage at diagnosis and 5-year cause-specific survival by race/ethnicity are shown in Figure 3. White and API women have the highest proportions of localized breast cancers (range, 63%-64%) and the smallest proportions of regional (range, 28%-30%) and distant (5%) stage disease. In contrast, black women have the smallest proportion of localized breast cancers (53%) and the largest proportions of regional (35%) and distant (8%) stage disease.

Cause-specific survival is used instead of relative survival to describe survival in racial and ethnic minorities, because estimates of life expectancy are not available for all racial/ethnic groups. Cause-specific survival is the probability of not dying of breast cancer within a specified number of years after diagnosis. Five-year breast cancer survival is highest for API women both overall and for each known stage, whereas black women have the lowest survival for each known stage at diagnosis. Racial differences in survival in part reflect differences in the distribution of breast cancer subtypes (Fig. 2). A study examining the risk of death among California breast cancer patients by tumor subtype and stage at diagnosis found the greatest disparities were for stage II and III HR+/HER2− breast cancers (31%-39% higher risk of death in blacks than whites). Another study found that, among patients diagnosed with small breast tumors (≤2.0 cm) during 2004 through 2011, black patients were more likely to present with lymph node metastases than white patients (24% vs 18%, respectively). Poverty, lower levels of educational attainment, and a lack of health insurance are also associated with lower breast cancer survival largely because of limited access to care.

Long-term incidence trends by age

Trends in incidence rates for female breast cancer by age at diagnosis are presented in Figure 4. Much of the historic increases in breast cancer incidence rates reflect changes in reproductive patterns, such as delayed childbearing and having fewer children, which are recognized risk factors for breast cancer. In the 1980s, breast cancer incidence rates increased rapidly in women aged 40 years and older, largely due to greater use of mammography screening. Subsequently, incidence rates stabilized for women in their 40s but continued to increase through much of the 1990s in women aged 50 years and older. This increasing trend in older women may reflect rising rates of obesity and the use of menopausal hormones, both of which increase the risk of postmenopausal breast cancer, as well as further increases in the prevalence of mammography screening.

Around the year 2000, incidence rates began to decline in women aged 50 years and older; and, between 2002 and 2003, breast cancer rates decreased sharply, likely because of the decreased use of menopausal hormones after the 2002
publication of the Women’s Health Initiative randomized trial results linking the use of combination hormone therapy to breast cancer and heart disease.43–45 The decline occurred primarily in white women and for HR+ disease.44,46 This trend also may reflect small declines in mammography screening since 2000. The percentage of women aged 40 years older who reported having a mammogram within the past 2 years increased from 29% in 1987 to 70% in 2000, declined 3.4 percentage points from 2000 to 2005, and has since been relatively stable.47 Similar reversals in breast cancer incidence trends have been observed in other high-income countries.48–53

Most recently, breast cancer incidence rates in the United States were stable for women in their 50s from 2006 to 2012 but increased for women in their 60s (1.0% per year since 2004) and women aged 70 years and older (1.2% per year since 2005). Incidence rates have been stable for women in their 40s since 1986. Among women ages 20 to 39 years, incidence rates increased slightly (0.6% per year) from 1994 to 2012.

**Incidence trends by race/ethnicity**

During 2008 through 2012 (the most recent 5 years of data available), overall breast cancer incidence rates increased among black women (0.4% per year) and API women (1.5% per year) but did not change significantly among white, Hispanic, or AI/AN women. Notably, breast cancer incidence rates for whites and blacks in the 9 SEER areas converged in 2012, reflecting the increase in incidence in black women and relatively stable rates in white women (Fig. 5). Incidence rates for AI/AN women are less stable than for other racial and ethnic groups, because high-quality data for this group are only available from limited geographic areas. We previously noted that the increase in incidence rates in black women has been driven by increases in ER+ breast cancers.54 This trend in part may reflect the rising rates of obesity in black women, which increased from 39% in 1999 through 2002, to 49% in 2003 through 2006, to 58% in 2009 through 2012.21 Obesity is a risk factor for postmenopausal breast cancer, and a recent study reported that a high recent body mass index was associated with an increased risk of ER+ breast cancer in black women (odds ratio, 1.31; 95% confidence interval, 1.02-1.67 for a body mass index of ≥35 kg/m² vs <25 kg/m²).55

We further examined breast cancer incidence trends by stage at diagnosis for 4 racial/ethnic groups (Fig. 6, Table 3). In the most recent period, incidence rates for localized breast cancers increased among white (0.9% per year during 2004-2012), black (2.4% per year during 2006-2012), and API (0.8% per year during 1992-2012) women but were stable among Hispanic women. Conversely, rates for regional-stage tumors decreased in white women (−1.3% per year during 1999-2012) and were stable in the most recent period for black and API women. Incidence rates for regional-stage breast cancer also declined for Hispanic
women during 2000 through 2010 and have since stabilized. The decreasing trends in regional-stage disease among white and Hispanic women may reflect a shift toward earlier stage at diagnosis. Rates of distant-stage tumors increased in white, black, and API women, but not in Hispanic women; however, in all 4 groups, the rates of unstaged tumors declined sharply, which likely reflects more complete staging of advanced tumors.

**Long-term mortality trends**

Figure 4 also illustrates national trends in mortality rates for breast cancer by age at death. Overall breast cancer mortality rates decreased 36% from 1989 to 2012 after slowly increasing for many years (0.4% annually since 1975). As a result of this decline, 249,000 breast cancer deaths have been averted in US women from 1990 to 2012 (Fig. 7). Death rates from breast cancer have decreased in all age groups, ranging from a

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**FIGURE 6. Trends in Female Breast Cancer Incidence Rates by Stage at Diagnosis and Race/Ethnicity, United States, 1992 to 2012.**

Rates are per 100,000 females, age adjusted to the 2000 US standard population, and adjusted for reporting delay. NH indicates non-Hispanic. Dots indicate observed, data and lines represent modeled trends based on Joinpoint analyses. Sources: Surveillance, Epidemiology, and End Results program, National Cancer Institute, 2015.
decline of 1.5% per year in women aged 70 years and older to 2.8% per year in women ages 20 to 39 years. Declines in breast cancer mortality rates have been attributed to both improvements in treatment (e.g., adjuvant chemotherapy and hormonal therapy in the 1980s and targeted therapies in the 1990s) and early detection.56,57

Mortality trends by race/ethnicity

Trends in breast cancer mortality rates by race/ethnicity are also shown in Figure 5. From 2003 through 2012, breast cancer mortality rates declined annually by 1.8% in whites, 1.5% in Hispanics, 1.4% in blacks, and 1.0% in APIs but remained unchanged among AI/ANs.4 A striking divergence in long-term breast cancer mortality trends between black and white women emerged in the early 1980s and has since continued to widen (Fig. 5); and, by 2012, mortality rates were 42% higher in black women than in white women. This mortality difference likely reflects a combination of factors, including differences in incidence rates (at least during the recent time period), stage at diagnosis, tumor characteristics, obesity, and comorbidities as well as access, adherence, and response to state-of-the-art treatments.15,16,58 The racial disparity may also reflect differences in the quality of mammography screening and delayed follow-up for abnormal mammography findings.59,60

### TABLE 3. Trends in Female Breast Cancer Incidence Rates by Stage at Diagnosis and Race/Ethnicity, United States, 1992 to 2012

|                | TRENDS 1 |                  | TRENDS 2 |                  | TRENDS 3 |                  | TRENDS 4 |                  |
|----------------|----------|------------------|----------|------------------|----------|------------------|----------|------------------|
|                | YEARS    | APC              | YEARS    | APC              | YEARS    | APC              | YEARS    | APC              |
| Non-Hispanic white |          |                  |          |                  |          |                  |          |                  |
| All stages     | 1992-1999| 1.7*             | 1999-2004| −2.3*            | 2004-2012| 0.3              |
| Localized      | 1992-1999| 1.8*             | 1999-2004| −2.7*            | 2004-2012| 0.9*             |
| Regional       | 1992-1996| −0.1             | 1996-1999| 4.5              | 1999-2012| −1.3*            |
| Distant        | 1992-2006| 0.2              | 2006-2012| 2.8*             |          |                  |
| Unstaged       | 1992-1997| 0.3              | 1997-2000| −12.3*           | 2000-2012| −4.9*            |
| Non-Hispanic black |        |                  |          |                  |          |                  |          |                  |
| All stages     | 1992-2012| 0.4*             |          |                  |          |                  |          |                  |
| Localized      | 1992-2006| 0.1              | 2006-2012| 2.4*             |          |                  |          |                  |
| Regional       | 1992-2012| 0.2              |          |                  |          |                  |          |                  |
| Distant        | 1992-2012| 1.4              |          |                  |          |                  |          |                  |
| Unstaged       | 1992-2012| −5.9*            |          |                  |          |                  |          |                  |
| Asian/Pacific Islander |     |                  |          |                  |          |                  |          |                  |
| All stages     | 1992-1994| −4.6             | 1994-1997| 6.9              | 1997-2005| −0.7             | 2005-2012| 1.5*            |
| Localized      | 1992-2012| 0.8*             |          |                  |          |                  |          |                  |
| Regional       | 1992-2000| 3.1*             | 2000-2012| −0.6             |          |                  |          |                  |
| Distant        | 1992-2012| 1.3*             |          |                  |          |                  |          |                  |
| Unstaged       | 1992-2012| −2.4*            |          |                  |          |                  |          |                  |
| Hispanic       |          |                  |          |                  |          |                  |          |                  |
| All stages     | 1992-2012| 0.2              |          |                  |          |                  |          |                  |
| Localized      | 1992-2012| 0.4*             |          |                  |          |                  |          |                  |
| Regional       | 1992-1997| −0.5             | 1997-2000| 5.3              | 2000-2010| −1.2*            | 2010-2012| 4.0             |
| Distant        | 1992-2012| 0.6              |          |                  |          |                  |          |                  |
| Unstaged       | 1992-2012| −4.1*            |          |                  |          |                  |          |                  |

APC indicates annual percent change.

*The APC is statistically different from zero.

Source: Surveillance, Epidemiology, and End Results Program.3

### FIGURE 7. Total Number of Female Breast Cancer Deaths Averted From 1990 to 2012.

The blue line represents the actual number of breast cancer deaths recorded in each year, and the red line represents the number of breast cancer deaths that would have been expected if breast cancer death rates had remained at their peak rate in 1989.
**TABLE 4. State Variation in Female Breast Cancer Incidence and Mortality Rates and Mammography Usage by Race**

| STATE      | NON-HISPANIC WHITE | INCIDENCE 2008-2012 | MORTALITY RATE 2008-2012 | NON-HISPANIC BLACK | INCIDENCE 2008-2012 | MORTALITY RATE 2008-2012 | BLACK/WHITE INCIDENCE RATIO |
|------------|---------------------|----------------------|--------------------------|---------------------|----------------------|--------------------------|-----------------------------|
|            | RECENT MAMMOGRAM (%) AGES 45+ 2012* | % IN SITU† | % REGIONAL/ DISTANT‡ | INVASIVE OVERALL RATE* | 81 18% 43% 125.9 30.7 1.07§ | | | |
| Alabama    | 77 18% 34% 117.5 20.4 | | | | | | |
| Alaska     | 70 22% 35% 126.7 21.2 | | | | | | |
| Arizona    | 74 19% 32% 118.8 20.6 | | | | | | |
| Arkansas   | 68 18% 33% 107.7 21.4 | | | | | | |
| California | 80 18% 33% 140.5 24.2 | | | | | | |
| Colorado   | 73 20% 33% 127.7 20.1 | | | | | | |
| Connecticut| 81 24% 30% 141.1 20.6 | | | | | | |
| Delaware   | 81 24% 31% 126.8 21.9 | | | | | | |
| Dist. of Columbia | 80 23% 31% 164.4 24.1 | | | | | | |
| Florida    | 75 18% 32% 120.4 21.3 | | | | | | |
| Georgia    | 77 20% 33% 125.8 21.2 | | | | | | |
| Hawaii     | 75 19% 31% 138.3 18.9 | | | | | | |
| Idaho      | 76 20% 34% 133.2 22.9 | | | | | | |
| Illinois   | 70 18% 34% 119.7 22.3 | | | | | | |
| Indiana    | 78 19% 33% 124.3 20.9 | | | | | | |
| Iowa       | 78 17% 33% 123.1 21.3 | | | | | | |
| Kansas     | 77 17% 33% 121.6 22.1 | | | | | | |
| Kentucky   | 75 17% 35% 121.2 21.9 | | | | | | |
| Louisiana  | 81 22% 32% 125.2 19.2 | | | | | | |
| Maine      | 80 20% 32% 133.5 22.1 | | | | | | |
| Maryland   | 86 24% 28% 141.7 20.9 | | | | | | |
| Massachusetts | 78 21% 33% 121.2 22.1 | | | | | | |
| Michigan   | 81 1% 34% 133.2 22.9 | | | | | | |
| Minnesota  | 78 19% 33% 119.7 22.3 | | | | | | |
| Mississippi| 70 16% 35% 139.9 20.4 | | | | | | |
| Missouri   | 75 18% 35% 124.6 22.6 | | | | | | |
| Montana    | 68 19% 35% 123.5 20.3 | | | | | | |
| Nebraska   | 72 19% 33% 123.4 19.7 | | | | | | |
| Nevada     | 72 19% 33% 121.2 25.4 | | | | | | |
| New Hampshire | 82 21% 31% 136.2 20.5 | | | | | | |
| New Jersey | 77 24% 32% 140.7 24.7 | | | | | | |
| New Mexico | 70 16% 32% 125.6 22.4 | | | | | | |
| New York   | 78 25% 31% 138.9 21.8 | | | | | | |
| North Carolina | 78 18% 33% 128.9 21.0 | | | | | | |
| North Dakota | 77 18% 36% 122.9 19.7 | | | | | | |
| Ohio       | 76 18% 35% 121.0 23.2 | | | | | | |
| Oklahoma   | 69 17% 35% 116.9 23.0 | | | | | | |
| Oregon     | 74 19% 32% 130.4 21.5 | | | | | | |
| Pennsylvania | 77 20% 34% 129.0 22.6 | | | | | | |
| Rhode Island| 84 21% 30% 135.8 20.1 | | | | | | |
| South Carolina | 72 19% 33% 125.9 21.1 | | | | | | |
| South Dakota | 76 20% 35% 128.0 20.9 | | | | | | |
| Tennessee  | 76 18% 34% 120.7 21.2 | | | | | | |
| Texas      | 72 18% 32% 124.2 21.1 | | | | | | |
| Utah       | 71 18% 38% 115.9 21.7 | | | | | | |
| Vermont    | 79 22% 30% 129.1 18.7 | | | | | | |
| Virginia   | 79 22% 32% 127.8 21.6 | | | | | | |
| Washington | 75 21% 32% 139.6 21.3 | | | | | | |
| West Virginia | 75 17% 34% 111.5 22.7 | | | | | | |
| Wisconsin  | 80 20% 34% 126.5 20.7 | | | | | | |
| Wyoming    | 66 15% 35% 113.3 19.9 | | | | | | |
| United States | 76 20% 33% 128.1 21.9 | | | | | | |
| Range      | 66-86 15%-25% 28%-38% 107.7-164.4 18.7-25.4 68-89 14%-27% 35%-49% 94.0-141.7 21.7-35.0 | | | | | | |

*All rates are per 100,000 and age-adjusted to 2000 US standard population.
†Recent mammogram is defined as having had a mammogram within the past 2 years.
‡The denominators for percent in situ include all breast cancers. The denominators for percent regional/distant include all invasive breast cancers.
§The black:white incidence rate ratio is significantly different from 1.00 (P < .05).
||Statistic could not be calculated; for Behavioral Risk Factor Surveillance System estimate of mammography screening, percentage was not calculated if there were fewer than 50 respondents; for incidence and mortality, statistics were not calculated if there were 25 or fewer cases or deaths. Incidence data are not available for Minnesota. Data on stage distribution were not available for Arkansas and Nevada.

Sources: Mammography: Behavioral Risk Factor Surveillance System 2012, Centers for Disease Control and Prevention. Incidence: North American Association of Central Cancer Registries. Overall US incidence data do not include data from Arkansas, Minnesota, or Nevada. Mortality: National Center for Health Statistics, Centers for Disease Control and Prevention.
Furthermore, although findings from national surveys indicate that current mammography screening rates are similar or even slightly higher in black women than in white women, studies suggest that these surveys may overestimate mammography rates, and more so for blacks than for whites.61–63

**Variation in mammography use, incidence, and mortality by state**

State variations in mammography screening prevalence, breast cancer incidence and mortality rates, and the proportion of breast cancers diagnosed at in situ and regional/distant stages are presented in Table 4. In 2012, the prevalence of recent mammography screening within the past 2 years among white women aged 45 years and older ranged from 66% in Wyoming to 86% in Massachusetts. Thirty-four states had sample sizes large enough to estimate the prevalence of mammography screening within the past 2 years in black women aged 45 years and older, which ranged from 68% in Colorado to 89% in Maryland.

Breast cancer incidence rates ranged from 107.7 cases per 100,000 females in Arkansas to 164.4 cases per 100,000 females in Washington, DC among white women and from 94.0 per 100,000 females in Minnesota to 141.7 cases per 100,000 females in Alaska among black women. We examined rate ratios for 42 states and Washington, DC with stage-adjusted rate ratios for both blacks and whites. In 7 states (Alabama, Kentucky, Louisiana, Mississippi, Missouri, Oklahoma, and Tennessee), breast cancer incidence rates were significantly higher in black women than in white women, whereas rates were lower for black women in 11 states and Washington, DC. In 24 other states, rates were not significantly different between blacks and whites. Reasons for higher breast cancer incidence rates among blacks than whites in certain states are not clear but may have resulted in part from the decline in incidence rates associated with a reduction in postmenopausal hormone therapy use that was observed in white women but not black women coupled with increasing incidence rates in black women.46,54

When comparing incidence rates among states, it is also important to consider that incidence rates reflect the intensity of screening as well as disease occurrence. The percentage of in situ breast cancers, an indicator of mammography utilization, varied from 15% in Wyoming to 25% in New York among white women and from 14% in West Virginia to 27% in Connecticut among black women. The proportion of regional/distant stage cancers ranged from 28% in Massachusetts to 38% in Utah among white women and from 35% in Rhode Island to 49% in Wisconsin among black women.

We assessed the relationship between mammography screening rates in 2012 and breast cancer stage at diagnosis during 2008 through 2012. State-level mammography screening prevalence was positively correlated with the percentage of breast cancers diagnosed at in situ stage (Pearson correlation coefficient \( r = 0.65; P < .001 \)) and negatively correlated with the percentage of breast cancers diagnosed at late stages \( (r = -0.63; P < .001) \) among white women. Among black women, state-level mammography screening prevalence was also correlated with in situ diagnoses \( (r = 0.49; P = .003) \) but not with late-stage diagnoses \( (r = -0.31; P = .08) \).

Despite generally similar current and historically lower incidence rates, breast cancer death rates are higher in black women than in white women. Breast cancer death rates among white women range from 18.7 in Vermont to 25.4 in Nevada. In contrast, breast cancer death rates among black women range from 21.7 in Minnesota to 35.0 in Oklahoma. We also examined trends in breast cancer mortality rates from 2003 through 2012 by state (data not shown). Death rates decreased for white women in all 50 states and for black women in 27 of 30 states with sufficient data to examine trends. In contrast, breast cancer death rates for black women were stable during 2003 through 2012 in 3 states: Mississippi, Oklahoma, and Wisconsin. Although 88% of black women reported receiving a recent mammogram in Wisconsin, 49% of breast cancers were diagnosed at regional or distant stages during 2008 through 2012 (Table 4).

**Conclusion**

From 1989 to 2012, breast cancer death rates have decreased by 36%; and, as a result, 249,000 US breast cancer deaths have been averted during this time period. This decrease was evident in all racial/ethnic groups except AI/ANs. Nevertheless, disparities in breast cancer mortality rates between black and white women continue to widen in the United States, with rates 42% higher among blacks in 2012. This pattern is likely to continue—at least in the near future—in view of the increasing trends in breast cancer incidence rates in black women. Breast cancer incidence rates are higher among black women than white women in 7 states, most of which are located in the South. Black women are also disproportionately diagnosed with triple-negative breast cancers.

The World Cancer Research Fund International estimates that one third of breast cancers could be prevented through healthy behaviors, including maintaining a healthy body weight, engaging in regular physical activity, and not drinking alcohol.64 There is growing evidence that high levels of fruit and vegetable consumption may reduce the risk of HR-negative breast cancer.65 These findings are supported by studies linking lower breast cancer risk to higher blood levels of carotenoids.66,67 In addition, the Collaborative Group on Hormonal Factors in Breast Cancer reviewed 47 studies from 30 countries and concluded that the risk of breast cancer was reduced by 4% for every 12 months of breastfeeding.68 More recent studies suggest that the protective effect may be stronger for or even limited to triple-negative breast cancers.69–75
Clinicians should encourage their patients to have regular screening mammography. The American Cancer Society has recently updated their breast cancer screening guidelines for average-risk women. Annual mammography is recommended for women who are ages 45 to 54 years; women age 55 years and older should transition to biennial screening or have the opportunity to continue screening annually, continuing as long as their overall health is good and life expectancy is 10 years or more. Women between the ages of 40 and 44 should have the opportunity to begin annual mammography screening. It is also important that patients at high risk of breast cancer are identified and offered appropriate screening and follow-up. In addition, increased efforts are required to ensure that all segments of the population receive consistent follow-up of abnormal results, prompt diagnosis, and the delivery of high-quality treatment for breast cancer.

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