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ORIGINAL REPORT

Breast Cancer Trends Among Black and White Women in the United States

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A B S T R A C T

Purpose

Overall US breast cancer mortality rates are higher among black women than white women, and the disparity is widening. To investigate this disparity, we examined incidence data and changes in mortality trends according to age, year of death (calendar period), and date of birth (birth cohort). Calendar period mortality trends reflect the effects of new medical interventions, whereas birth cohort mortality trends reflect alterations in risk factors.

Patients and Methods

Incidence data were obtained from the Connecticut and National Cancer Institute Surveillance, Epidemiology, and End Results registries and mortality data were obtained from the National Center for Health Statistics. Changes in age, period, and cohort mortality trends were analyzed with Poisson regression.

Results

For both races, breast cancer incidence rates for localized and regional disease diverged in the late 1970s. Almost concurrently, overall mortality rates diverged among blacks and whites. For both races, mortality increases with age, but blacks have higher mortality at age younger than 57. The calendar period curves revealed declining mortality for whites over the entire study period. For blacks, calendar period mortality declined until the late 1970s, and then sharply increased. After 1994, calendar period mortality declined for both. For women born between 1872 and 1950, trends in mortality were similar for blacks and whites. For women born after 1950, mortality decreased more rapidly for blacks.

Conclusion

The widening racial disparity in breast cancer mortality seems attributable to calendar period rather than birth cohort effects. Thus, differences in response or access to newer medical interventions may largely account for these trends.

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INTRODUCTION

Population-based statistics in the United States indicate that overall age-adjusted breast cancer mortality rates are higher among black women than white women, and the disparity is increasing.[1] The etiology of the widening racial disparity is poorly understood. However, these trends might be attributable to disparities in health care quality or access, different responses to newer medical interventions, or alterations in risk factors (such as nutrition, physical activity, obesity, or childbearing practices).[2-5]

To further explore these possibilities, we examined temporal trends in incidence and mortality, and fit age-period-cohort (APC) models to the US breast cancer mortality data. Thus, we calculated changes in breast cancer mortality trends according to age at death, year of death (calendar period), and date of birth (birth cohort).[6,7] Calendar period trends reflect the effects of new medical interventions (screening and treatment), including access or response to those interventions, whereas birth cohort trends reflect alterations in risk factors.[6,7]

Previous studies have analyzed short-term breast cancer mortality trends among black and white women in the United States.[8,9] In this study, we expand on those earlier reports, and provide a long-term descriptive overview of these trends.

PATIENTS AND METHODS

We used SEER*Stat (Surveillance Research Program) to determine trends in breast cancer incidence from the population-based datasets of the Connecticut Tumor Registry and Surveillance, Epidemiology, and End Results (SEER).[10-12] The Connecticut registry provides information dating back to the 1930s, but did not provide separate data for blacks and whites until the 1970s. In the SEER data set, separate data are provided for blacks and whites.

We determined trends in breast cancer mortality in the United States using the cancer mortality data collected from each state by the National Center for Health Statistics of the Centers for Disease Control. The analysis was conducted for whites and nonwhites during the period 1952 to 2001 using SEER*Stat.[12] Separate data for blacks were not available until 1972. However, before the early 1970s, mortality rates for nonwhites must have closely approximated mortality rates for blacks. Indeed, in 1950, 95.5% of US nonwhites were black, and this had declined to 88.7% in 1970.

We calculated age-adjusted (2000 US standard) incidence and mortality rates per 100,000 woman-years for the time periods starting with 1937 to 1941 for Connecticut incidence, 1977 to 1981 for the original nine SEER registries, 1952 to 1956 for US mortality among whites and nonwhites, and 1972 to 1976 for US mortality among blacks. All trends extended through 1997 to 2001, the most recent time period for which data were available. Incidence rates were further evaluated according to stage at diagnosis: localized, regional, distant, or unknown. The temporal trends in incidence and mortality rates were plotted using log-linear scales such that a slope of 10 degrees portrays an annual percentage change of 1%, or a *y*- to *x*-axis ratio such that the length of one log cycle equals 40 years.[13]

APC models using Poisson regression were fitted to the breast cancer mortality data using 5-year age and calendar period intervals. APC modeling is a multivariate analysis that estimates the age, period, and cohort factors simultaneously, as described in previous reports.[6,7] Thus, age-related trends in mortality were adjusted for period and cohort factors, calendar period trends were adjusted for age and cohort factors, and birth cohort trends were adjusted for age and period factors. For whites and nonwhites, there were 13 age intervals (ranging from 20 through 24 to 80 through 84), 10 period intervals (ranging from 1952 through 1956 to 1997 through 2001), and 22 birth-cohort intervals ranging from 1867 through 1877 to 1972 through 1982). Each birth cohort is referred to by the fifth year in the interval (for example, the 1867 to 1877 birth cohort will be referred to by 1872). For blacks, there were 13 age intervals (ranging from 20 through 24 to 80 through 84), six period intervals (ranging from 1972 through 1976 to 1997 through 2001), and 18 birth-cohort intervals (ranging from 1887 through 1897 to 1972 through 1982).

Identifiable differences in linear contrasts were used to examine changes in slopes of long-term linear trends for age, calendar-period, and birth-cohort effects. The same contrasts were examined for whites, nonwhites, and blacks. The calendar period and birth cohort effects were plotted using a *y*- to *x*-axis ratio such that a 0.1 effect difference was equal to a 10-year difference. The age effect was 10 times larger, such that the *y*- to *x*-axis ratio of 1:1 portrays a unit effect equal to 10 years.[13]

RESULTS

Figure 1 depicts overall trends in breast cancer incidence and mortality. Incidence rates have increased gradually in Connecticut since the 1950s and in SEER since the 1970s, with sharper increases from the late 1970s to the early 1990s, reflecting the increased use of mammography screening. Overall breast cancer mortality rates for blacks and whites were similar until the late 1970s, when mortality rates for blacks increased. Rates have declined among whites since the late 1980s and among blacks during the 1990s.

Before the 1960s, stage of disease was not well specified in the Connecticut incidence data (Fig 2). During the 1960s and early 1970s, the proportion with stage unknown plummeted, and rates of localized and regional disease decreased in tandem. Beginning in the late 1970s, in both the Connecticut and SEER registries, the incidence of localized disease increased and regional disease decreased. The SEER graph shows that the divergence in the incidence of localized and regional disease is evident for both blacks and

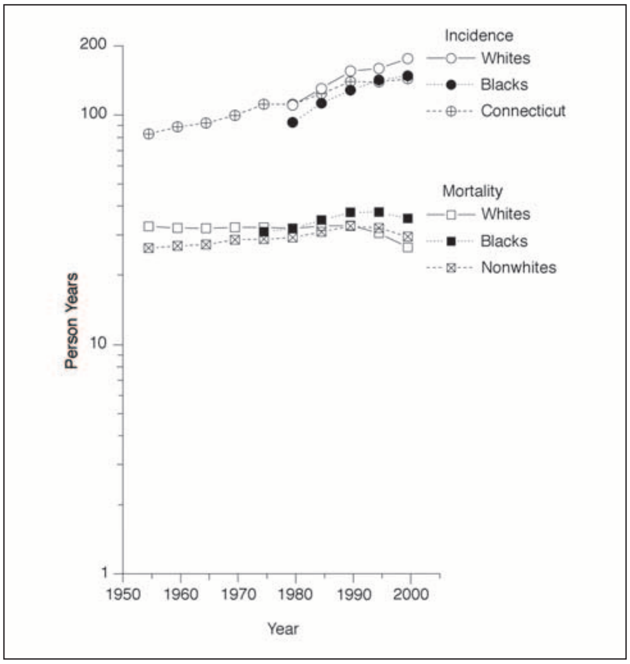

Fig 1. Female breast cancer trends by race: incidence in the nine Surveillance, Epidemiology, and End Results (SEER) areas (1977 through 1981 to 1997 through 2001), Connecticut (1952 through 1956 to 1997 through 2001), and US mortality (1952 through 1956 to 1997 through 2001; rates age adjusted, 2000 US standard).

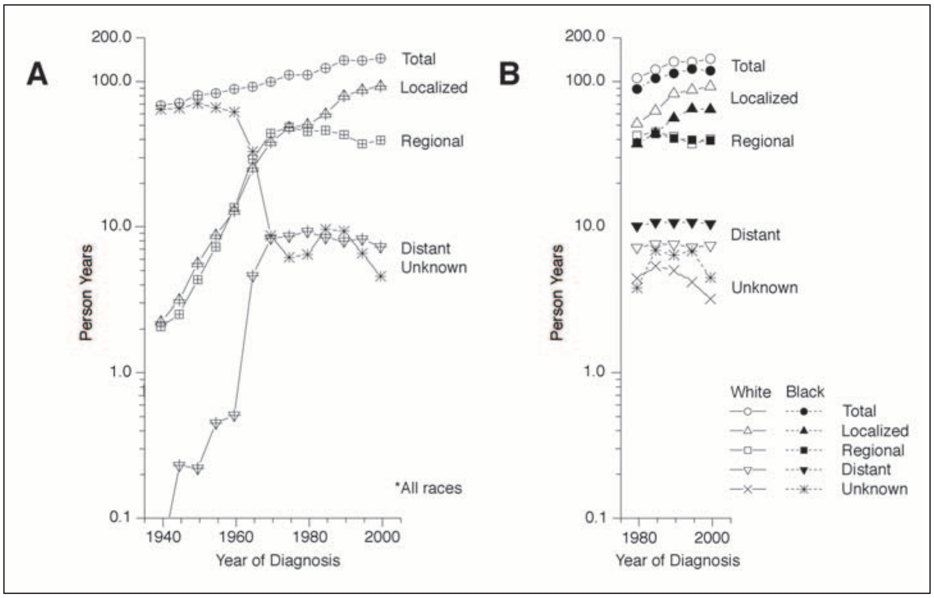

Fig 2. Female breast cancer incidence trends in Connecticut (1937 through 1941 to 1997 through 2001) and in the nine Surveillance, Epidemiology, and End Results (SEER) areas (1977 through 1981 to 1997 through 2001) by race, total, and SEER historic stage A (rates age adjusted, 2000 US standard).

whites from about 1977 onward. The consistently higher incidence of total breast cancer among whites is due solely to higher rates of localized disease. Rates of regional disease are similar among whites and blacks, whereas rates of distant disease are higher among blacks.

The effect of age on breast cancer mortality is shown in Figure 3. The age-specific mortality curves indicate that whites and blacks have similar overall patterns: breast cancer mortality increases with age, with the rate of increase diminishing considerably after the menopause. However, blacks have higher age-specific mortality until approximately age 57. Thereafter, there is an ethnic crossover, and mortality for whites is higher.

The calendar period effects for breast cancer mortality are depicted in Figure 4. A decline in the calendar period slope is evident for whites since 1952. A similar decline is evident for nonwhites and blacks until the late 1970s. Thereafter, blacks experienced a sharp increase in the calendar period slope, which stabilized around 1994. After 1994, both racial groups show declines in the calendar period slopes, with whites seemingly showing the sharpest declines.

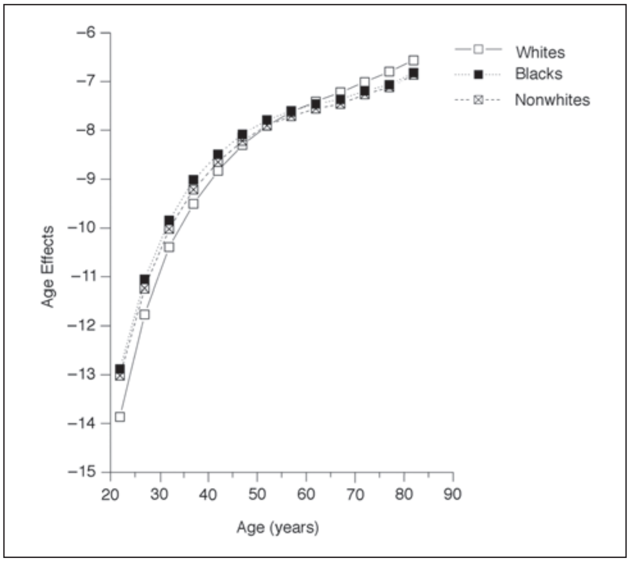

Fig 3. Age-specific trends in breast cancer mortality. Using data from the National Center of Health Statistics from 1952 to 2001, Poisson regression was used to model breast cancer mortality rates as a function of age at death.

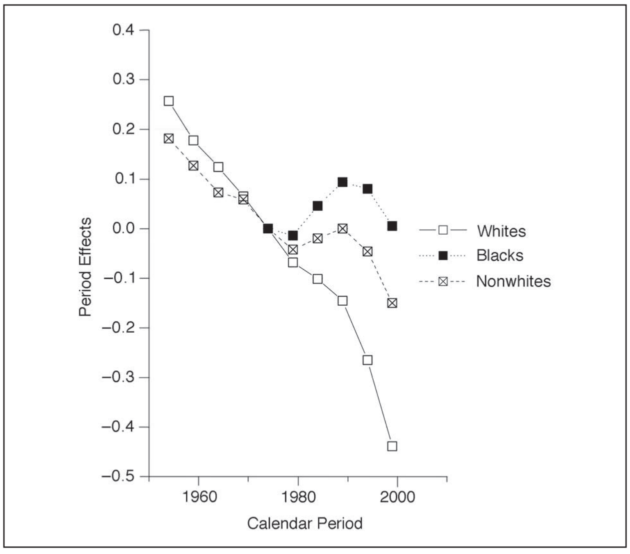

Fig 4. Calendar period trends in breast cancer mortality. Using data from the National Center of Health Statistics from 1952 to 2001, Poisson regression was used to model breast cancer mortality rates as a function of date of death.

The birth cohort effects for breast cancer mortality are depicted in Figure 5. An increase in slope, indicating an increase in breast cancer mortality, is evident for both racial groups for the period extending from 1872 to about 1920. For women born after this period, there is a plateau in the slope. However, in the most recent birth cohorts (women born after 1950), breast cancer mortality seems to have decreased more for blacks than for whites.

DISCUSSION

The overall age-adjusted breast cancer mortality rates for black and white women in the United States diverged in the late 1970s. Before that period, there was little disparity in overall mortality. For both blacks and whites, age-specific mortality increases with age, although blacks have higher mortality before age 57 (Fig 3). In the birth cohort curves, mortality trends seem similar, except in the most recent cohorts, in which blacks experience greater declines in mortality (Fig 5). However, the calendar period curves show that blacks experienced a sharp increase in mortality in the late 1970s, whereas whites experienced a continuous decline since about 1952 (Fig 4). Thus, the racial disparity in breast cancer mortality, dating back to the late 1970s (Fig 1), seems largely attributable to calendar period rather than birth cohort effects.

The calendar period trends reflect the impact of novel medical interventions, such as screening and treatments, including access or response to those interventions. One might speculate that the decline in calendar period mortality from the 1950s to the late 1970s, evident for all racial groups, is due to an increase in breast cancer awareness and the detection of smaller, palpable tumors.[14] However, the sharp increase in calendar period slope among blacks (and the moderation in the decline among whites) in the late 1970s is puzzling. Ironically, this coincided with the introduction of mammography screening in the United States, as indicated by the divergence of localized and regional disease in Figure 2.[15]

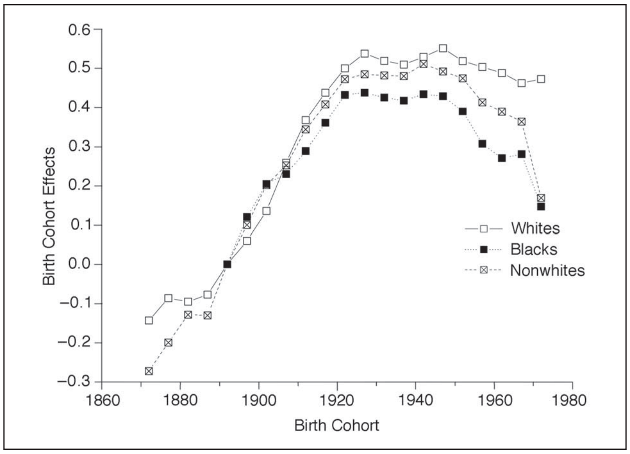

Fig 5. Birth cohort trends in breast cancer mortality. Using data from the National Center of Health Statistics from 1952 to 2001, Poisson regression was used to model breast cancer mortality rates as a function of date of birth.

In recent years, several investigators have drawn attention to the mortality paradox associated with mammography screening in women age 40 to 49.[16-18] These investigators point out that, in all of the randomized trials, an increase in breast cancer mortality is evident 3 to 10 years after initiation of screening in premenopausal women, with declines in mortality thereafter. Given that black women have higher rates of premenopausal cancers, this may potentially account for the sharp increase in calendar period slope after the introduction of mammography screening in the late 1970s. This transient increase in mortality may partly be attributable to the effects of treatment, which are associated with the diagnosis of a large reservoir of occult cancers with mammography. Recently, some investigators have suggested that, in premenopausal women, extirpation of these occult cancers may accelerate the appearance of distant metastasis.[18-20]

Yet, the calendar period curves also show declines in mortality for both white and black women in the mid to late 1990s, with greater declines for whites. Clinical trials indicate that mammography screening reduces breast cancer mortality by approximately 25% in postmenopausal women, but this effect emerges 7 to 9 years after initiation of screening.[21] The mortality benefit is approximately 18% in premenopausal women, but it takes more than 11 years to see this effect in the randomized trials.[22-24] Thus, in the short term, the introduction of mammography screening might have transiently increased the calendar-period slope, but in the long term, it might have contributed to its decline.

The increased use of adjuvant systemic therapy (tamoxifen and polychemotherapy) has almost certainly also contributed to overall breast cancer mortality declines in the 1990s.[14] Several large, randomized trials have shown that adjuvant systemic therapy can effectively reduce breast cancer mortality by approximately 25% to 30%, and this benefit emerges 3 years after initiation of therapy.[25,26] By the early 1990s, tamoxifen and polychemotherapy were widely prescribed in the United States as adjuvant therapy for breast cancer.[27,28] A favorable effect on the population-based statistics would have been expected by the mid 1990s, and is evident in the calendar period curves.

Whites seemingly experienced greater calendar period declines between the mid to late 1990s, perhaps reflecting differences in health care access. Many blacks lack health insurance or have inadequate coverage, which may limit their access to screening or influence decisions concerning the administration of adjuvant systemic therapy.[5,29] During the late 1980s, the usage of mammography screening among blacks lagged behind that of whites, although the two groups now have similar rates of usage.[30] In addition, there is evidence that blacks are less likely to receive optimal adjuvant systemic therapy than whites.[31] Thus, the greater mammography usage among whites in the 1980s, as well as disparities in the administration of adjuvant systemic therapy, may partly account for the sharper calendar period declines among whites in the late 1990s.

We previously reported that breast cancer survival rates among blacks and whites have also diverged in the US Department of Defense health care system, where medical care is available at no cost to eligible beneficiaries.[32] We suggested that this may partly reflect the increased use of tamoxifen, which is only effective in patients with estrogen receptor–positive tumors.[25] Estrogen receptor–positive tumors are more common among white women (77%) than black women (57%).[33] Thus, white women are more likely to receive adjuvant tamoxifen therapy, and this might be contributing to the greater recent decline in calendar period slope among whites.

It is important to emphasize that the *y*-axis for the age-effects curve (Fig 3) is on a scale from −15 to −6 (ie, a factor of 9.0) compared with a scale of −0.3 to −0.6 (ie, a factor of 0.9) for the calendar-period and birth-cohort curves (Figs 4 and 5)—a 10-fold difference. This underscores the overwhelming effect of age on breast cancer mortality. Any change in the age-effects slope represents a 10 times greater effect when compared with similar changes in either the calendar period or birth cohort effects slopes. Although the shapes of the age-effects curves are similar for blacks and whites, blacks experience higher mortality at age younger than 57. Thereafter, there is an ethnic crossover, and mortality is higher for whites. This ethnic crossover largely reflects the greater rates of premenopausal breast cancers among blacks. Yet, these curves may also partly indicate age-related racial disparities in the impact of screening and treatment.

The major drawbacks of this study are that it is descriptive and we can only speculate about the etiologies of the changes in age, period, and cohort mortality trends. Although we suggest that mammography screening and adjuvant systemic therapy account for the calendar period trends, other unknown factors may also be responsible. Nonetheless, population-based mortality statistics provide the most basic measure of progress in the fight against breast cancer, and the impact of novel medical interventions should ultimately be reflected in these statistics.[34] Clinical trials have shown that mammography screening and adjuvant systemic therapy can effectively reduce breast cancer mortality, and both have been widely implemented during the last 30 years. These interventions have undoubtedly contributed to overall declines in US breast cancer mortality rates. However, the response or access to these medical interventions, as well as disparities in the quality of health care, may largely account for the diverging breast cancer mortality rates among black and white women.

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Authors' Disclosures of Potential Conflicts of Interest

The authors indicated no potential conflicts of interest.

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