Underlying Causes of the Black–White Racial Disparity in Breast Cancer Mortality: A Population-Based Analysis

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Background In the United States, a black-to-white disparity in age-standardized breast cancer mortality rates emerged in the 1980s and has widened since then.

Methods To further explore this racial disparity, black-to-white rate ratios (RRs_{BW}) for mortality, incidence, hazard of breast cancer death, and incidence-based mortality (IBM) were investigated using data from the National Cancer Institute's Surveillance, Epidemiology, and End Results program on 244 786 women who were diagnosed with breast cancer from January 1990 through December 2003 and followed through December 2004. A counterfactual approach was used to examine the expected IBM RRs_{BW}, assuming equal distributions for estrogen receptor (ER) expression, and/or equal hazard rates of breast cancer death, among black and white women.

Results From 1990 through 2004, mortality RR_{BW} was greater than 1.0 and widened over time (age-standardized breast cancer mortality rates fell from 36 to 29 per 100 000 for blacks and from 30 to 22 per 100 000 for whites). In contrast, incidence RR_{BW} was generally less than 1.0. Absolute hazard rates of breast cancer death declined substantially for ER-positive tumors and modestly for ER-negative tumors but were persistently higher for blacks than whites. Equalizing the distributions of ER expression in blacks and whites decreased the IBM RR_{BW} slightly. Interestingly, the black-to-white disparity in IBM RR_{BW} was essentially eliminated when hazard rates of breast cancer death were matched within each ER category.

Conclusions The black-to-white disparity in age-standardized breast cancer mortality was largely driven by the higher hazard rates of breast cancer death among black women, diagnosed with the disease, irrespective of ER expression, and especially in the first few years following diagnosis. Greater emphasis should be placed on identifying the etiology of these excess hazards and developing therapeutic strategies to address them.

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Over the last 15 years, age-standardized breast cancer mortality rates have improved in the United States (1–3). However, they have remained higher and declined more slowly among black women than among white women (4–11). In 2004, the disparity was 29 vs 22 breast cancer deaths per 100 000 woman-years in blacks and whites, respectively. Both biological and nonbiological factors have been proposed to contribute to this disparity, but the underlying causes remain unclear.

In a previous population-based study using age–period–cohort models, our group found that trends in age-specific mortality of breast cancer were largely driven by calendar period effects (5), reflecting changing practice patterns for early detection and/or treatment (12). These results suggested that differences in screening policies as well as response to or access to novel medical interventions could account for the racial differences in breast cancer mortality. Another study from our group that analyzed survivorship of case subjects diagnosed between 1990 and 2002 (1) showed that breast cancer mortality rates declined more over time in women with estrogen receptor–positive (ER+) tumors than in women with estrogen receptor–negative (ER−) tumors. All of these studies are consistent with the possibility that differences in population-based mortality rates between blacks and whites may reflect not only race-specific trends in incidence rates but also differential outcomes after diagnosis.

To elucidate the potential impact of racial differences in incidence rates, tumor characteristics, and outcomes after diagnosis on the observed racial gap in breast cancer mortality, we investigated temporal trends in black-to-white rate ratios for both breast cancer

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CONTEXT AND CAVEATS

Prior knowledge

Since the 1980s, a widening disparity in age-adjusted mortality rates for black and white women diagnosed with breast cancer has emerged.

Study design

Based on data from the National Cancer Institute's Surveillance, Epidemiology, and End Results program, the authors calculated temporal trends in black-to-white ratios of mortality, incidence, hazard for death from breast cancer, and incidence-based mortality (IBM), with some analyses stratified by estrogen receptor (ER) status and age.

Contribution

The work indicates that the black-to-white disparity in breast cancer mortality is largely due to a higher hazard of death in black women diagnosed with the disease irrespective of ER status.

Implications

Research into the reasons for relatively poor outcomes for black women with breast cancer is warranted.

Limitations

IBM analyses only captured the experience of women with breast cancer in the first five years following diagnosis.

From the Editors

incidence and mortality. We also examined the absolute annual hazard of breast cancer death among black and white women living with breast cancer according to ER status of the tumor to explore if absolute hazard rates differ among black and white women with ER+ and ER− tumors and whether these differences could explain the racial disparity in breast cancer mortality. These analyses of absolute hazard rates were complemented by an examination of black-to-white hazard rate ratios for ER+ and ER− tumors that adjusted for several potential confounders.

Finally, we used a novel counterfactual approach to explore whether (and to what extent) differences in ER status and/or hazard rates of breast cancer death among black and white women could have accounted for the observed widening racial gap in the age-standardized breast cancer mortality rate. The counterfactual approach aims to predict the "unobserved" outcomes that would be expected under different scenarios, assuming that an underlying statistical model describing the outcomes is valid. The counterfactual results may help guide causal inferences. This method has been increasingly used in medical and epidemiological studies to inform public health policy decisions (13,14). Our models were developed using data from the National Cancer Institute's (NCI) Surveillance, Epidemiology, and End Results (SEER) Registry. The broad coverage of this registry allows for estimates that are nationally representative, and the individual-level and ecological data collected by this registry make it possible to control for potential confounders.

Methods

Population Data

Breast cancer incidence case and population data were obtained from the NCI SEER 9 Registries Database for the years 1973–2004 (15). These registries cover approximately 10% of the US population (Table 1). Crude incidence rates were age adjusted to the 2000 US standard population. Age-standardized mortality rates investigated in this study were supplied to the SEER Program by the National Center for Health Statistics (16). Demographic and tumor characteristics recorded by SEER included age at diagnosis, American Joint Committee on Cancer (AJCC) stage (17), tumor grade, ER expression, County Attribute 2000's for percentage of people below the poverty level (18), and marital status. AJCC stage (I, II, III, and IV) is based on tumor size (in centimeters), axillary lymph node status (positive or negative), and distant metastasis (present or absent). Tumor grade was dichotomized into low and high. Low grade consisted of well-differentiated or moderately differentiated grades, whereas high grade was defined as poorly differentiated or undifferentiated grade. SEER recorded ER status as not done, positive, negative, borderline (undetermined whether positive or negative), ordered but results not on chart, unknown, or no information. Because SEER did not collect information on ER status until 1990, our primary analyses were limited to the time period January 1990 through December 2004. SEER also did not record the method of hormone receptor assay, but immunohistochemistry was likely used during the study period (19). For descriptive purposes, for each demographic or tumor characteristic, variables that did not match the above-mentioned categories were classified as "other or unknown."

Black-to-White Breast Cancer Incidence and Mortality Rate Ratios

We calculated crude black-to-white rate ratios (RRs_{BW}) for breast cancer mortality and incidence. These ratios provided empirical measures of racial disparity between blacks and whites. Mortality RR_{BW} was calculated for three age groups (<50, 50–69, and ≥70 years), selected to broadly approximate mammography screening prevalence: age less than 50 years (low to no screening), ages 50–69 years (likely screened), and age 70 and more years (low to no screening). We used linear regression with inverse variance to assess trends over time in the mortality RR_{BW}. The weights were obtained using the delta method (20) under the assumption that the numbers of deaths per year followed a Poisson distribution. We used the same approach to study the incidence RR_{BW}.

Hazard Rates of Breast Cancer Death Among Women Living With the Disease

We characterized the absolute annual hazard rates of death from breast cancer among women diagnosed from January 1990 through December 2003 and followed through December 2004. This analysis was based on individual follow-up of 244 786 case subjects (Table 1), stratified by race, period of diagnosis (1990–1996 and 1997–2004), and ER status. We used spline functions to estimate the hazard curves, as described previously (1,21). Hazard rate curves show the instantaneous rate of death (percentage dying per year) due to breast cancer in a specified time interval after initial diagnosis among women who are alive at the beginning of that time interval. This essentially model-free approach reveals the shape of the hazard curve, and it can accommodate adjustment for potential confounders through stratification. However, hazard rate curves do not provide a concise summary estimate of the hazard rate ratio.

Therefore, we used Cox models (22) to obtain a detailed characterization of the hazard RR_{BW}. For this analysis, we stratified the case subjects according to single year of diagnosis and ER status and estimated the relative hazard for blacks vs whites adjusted for age at diagnosis (<50, 50–69, and ≥70), AJCC stage (I, II, III, and IV), tumor grade (low and high), County Attribute for percentage of people below the poverty level (<10%, 10%–19%, and ≥20%) (18), and marital status (never married, married, separated, divorced, widowed, and unknown). The calendar year and ER status–specific hazard RRs_{BW} were then analyzed using the same approach as for the mortality RR_{BW} and incidence RR_{BW}, that is, weighted regression analysis.

To verify the assumption of proportional hazards in Cox regression analyses, we used Poisson regression to estimate absolute monthly hazard rates of death from breast cancer, stratified by ER status, age group, and calendar period, and adjusted for stage and grade. In these models, we fitted separate baseline hazard rates for blacks and whites using quadratic spline functions and graphically inspected these curves for proportionality.

Breast Cancer Incidence–Based Mortality

Incidence-based mortality (IBM) is a statistical tool for calculating population-based mortality rates according to tumor characteristics (in this case, ER expression) that are recorded in registry data. IBM provides an estimate of the cross-sectional mortality rate in the population as a whole for a specific tumor type in a given calendar period (23); similar to aggregate mortality rates, it is a statistical measure that reflects the combined impact of cancer incidence, case ascertainment, and treatment.

For this study, we calculated IBM according to the combination of race (black or white) and breast cancer ER status (ER+, ER−, or ER other or unknown) among women aged 25–84 years who died of breast cancer. Among the women who died from breast cancer, ER expression of the primary tumor was known for 81% of those diagnosed since 1990 (Table 1). Therefore, we computed IBM rates for the calendar years 1994 through 2003 so that we could stratify the rates according to ER expression using data ascertained from 1990. For example, the numerator of the rate for 1994 reflected breast cancer deaths that occurred in 1994 among women diagnosed during 1990–1994 at ages 20–79 years, and the rate for 1995 reflected deaths in 1995 among women diagnosed during 1991–1995. The denominators of the IBM rates were obtained from the midyear population counts. We used a bootstrap procedure to account for both uncertainty in the hazard rates of breast cancer death and random fluctuations in observed breast cancer incidence counts. The key assumptions of the IBM analyses are that women who have been diagnosed with breast cancer are subject to competing risks of death from breast cancer and death from all other causes. Furthermore, unbiased estimates of these risks can be obtained from registry data. Within this framework, we used a non-parametric approach that finely stratified the hazard estimates by age, period, and ER-status using the large cohort of cases in the SEER 17 database.

IBM rates should be interpreted as a characteristic of an entire population rather than of individuals, because the time scale is calendar time rather than time since diagnosis, and the denominator includes all women in the population whether or not they have breast cancer. Furthermore, the IBM rates in this study should be interpreted as a leading indicator of mortality trends based on early deaths among recently diagnosed cases; actual breast cancer mortality rates are substantially higher than the calculated IBM rates. A technical description of the IBM computations is given (see Supplementary Appendix A, which is available online).

Finally, we used a counterfactual approach to study whether IBM RR_{BW} would have been different if the proportions of tumors according to ER status, and/or the hazard rates of breast cancer death, had been similar among black and white women with breast cancer. For example, we computed the IBM in black women using data resembling the ER−/ER+ proportions in white women to estimate the potential influence of the disproportional ER expression among black and white women on breast cancer IBM RR_{BW}.

Results

There were 244 786 female breast cancer cases in SEER's Registries Database (Table 1) who were diagnosed during our study period (1990–2003) and followed through 2004. Black and white women comprised 8.3% and 84.9%, respectively, of the breast cancer cases in SEER. Compared with whites, blacks were younger at diagnosis and had tumors with higher AJCC stages, larger sizes, higher grade, more positive nodes, and had more ER− disease.

From 1990 through 2004, age-standardized breast cancer mortality rates decreased for both white and black women (Figure 1), however, it was persistently higher for the latter ($F = 125.4$, $P < .001$). The corresponding black-to-white breast cancer mortality rate ratio also varied over time according to age (Figure 2, A, $P = .01$ for age × race interaction), with the sharpest increases occurring among women younger than 50 years (secular rise of 0.03 per year, 95% confidence interval [CI] = 0.02 to 0.04 per year).

In contrast, the breast cancer age-specific incidence rate ratio remained relatively stable over time (Figure 2, B). Throughout the study period, breast cancer incidence rates were lower for black women of all ages (incidence RR_{BW} <1.0), except for the moderately higher rates that were seen among women who were younger than 50 years and were diagnosed before 1996.

We calculated annual hazard rates of breast cancer death among women living with the disease, stratified by race, period of diagnosis, and ER status (Figure 3). During the time periods 1990–1996 and 1997–2004, absolute annual hazard rates of breast cancer death were statistically significantly higher for black women with ER− tumors and black women with ER+ tumors compared with whites with the same tumor status. For example, between the years 1997 and 2004, absolute hazard rates in black women with ER− tumors peaked at 11% per year (95% CI = 10.0% to 12.3% per year) approximately 1.5 years after diagnosis. In contrast, among white women, the peak hazard rate occurred at the same time after diagnosis but was only 6.6% per year (95% CI = 6.2% per year to 6.9% per year). The absolute hazard rates for patients with ER+ tumors were substantially lower, but in these patients as well, the hazard rates for black women were approximately twice as high as the corresponding hazard rates in white women (Figure 3, B). A statistically significant decline in hazard rates was observed between the two examined calendar periods (1990–1996 and 1997–2004) for both white and black women with ER+ tumors.

Table 1. Descriptive statistics for 244 786 women with invasive female breast cancer in National Cancer Institute's Surveillance, Epidemiology, and End Results 9 Registry Database diagnosed from January 1990 to December 2003 and followed through 2004*

Variable	All case subjects		Blacks		Whites		*P*† for heterogeneity
	n	%	n	%	n	%	
Age							<.001
<50	56 627	23.1	6786	33.4	44 701	21.5	
50–70	105 062	42.9	8624	42.5	88 806	42.7	
≥70	83 097	33.9	4894	24.1	74 428	35.8	
AJCC stage							<.001
I	107 242	43.8	6208	30.6	93 587	45.0	
II	81 862	33.4	7694	37.9	68 302	32.8	
III	15 018	6.1	2039	10.0	12 028	5.8	
IV	10 647	4.3	1444	7.1	8540	4.1	
Other or unknown	30 017	12.3	2919	14.4	25 478	12.3	
Tumor size							<.001
≤2.0 cm	139 543	57.0	8746	43.1	121 467	58.4	
>2.0 cm	75 576	30.9	8345	41.1	61 882	29.8	
Other or unknown	29 667	12.1	3213	15.8	24 586	11.8	
Lymph nodes							<.001
Negative	129 680	53.0	8615	42.4	111 837	53.8	
Positive	66 645	27.2	6586	32.4	55 440	26.7	
Other or unknown	48 461	19.8	5103	25.1	40 658	19.6	
Tumor grade							<.001
Low	117 083	47.8	6955	34.3	101 753	48.9	
High	77 460	31.6	8620	42.5	63 489	30.5	
Other or unknown	50 243	20.5	4729	23.3	42 693	20.5	
Estrogen receptor							<.001
Not done	13 555	5.5	1393	6.9	11 403	5.5	
Positive	153 068	62.5	9293	45.8	132 922	63.9	
Negative	45 239	18.5	6000	29.6	35 916	17.3	
Borderline	1483	0.6	149	0.7	1267	0.6	
Results not on chart	8283	3.4	1062	5.2	6914	3.3	
Other or unknown	23 158	9.5	2407	11.9	19 513	9.4	
Persons below poverty level							<.001
<10%	144 929	59.2	5393	26.6	133 216	64.1	
10–19%	95 580	39.0	17 880	88.1	70 767	34.0	
≥20%	4277	1.7	31	0.2	3952	1.9	
Marital status							<.001
Never married	26 626	10.9	4652	22.9	19 936	9.6	
Married	133 828	54.7	7140	35.2	116 508	56.0	
Separated	1404	0.6	358	1.8	944	0.5	
Divorced	22 716	9.3	3008	14.8	18 546	8.9	
Widowed	52 363	21.4	4121	20.3	45 747	22.0	
Other or unknown	7849	3.2	1025	5.0	6254	3.0	

* Among 244 786 case subjects, 20 304 (8.3%) were black and 207 935 (84.9%) were white. Mean age of women in years (standard error of the mean) was 61.9 (0.03), 57.6 (0.10), and 62.7 (0.03) among all women, blacks, and whites, respectively. The corresponding median ages were 62 years, 56 years, and 63 years. N = number (or count); % = percentage of total cases. AJCC = American Joint Committee on Cancer.

† *P* values from χ^2 test (two-sided) for heterogeneity comparing black and white women.

Specifically, there was a 31.6% decline in the peak hazard rate in whites (95% CI = 28.1% to 32.7%) and a 27.7% decline (95% CI = 26.7% to 28.8%) in the peak for blacks. In contrast, there was a smaller relative decline in the hazard rates for both black and white women with ER− tumors, and this decline occurred after the early hazard peak (Figure 3, A).

Next, we analyzed the hazard of breast cancer death RR_{BW} for each calendar year of diagnosis among women with ER− and ER+ tumors adjusted for age at diagnosis, AJCC stage, tumor grade, and socioeconomic status (based on a County Attribute for percentage of people below the poverty level and marital status) (Figure 4). For women with ER− tumors (Figure 4, A), the risk of breast cancer death was generally higher among black women than white women (hazard RR_{BW} >1.0 except for case subjects who were older than 70 years at diagnosis; for this group, the values were scattered above and below the referent line [RR_{BW} = 1.0]). A statistically significant decline with time (P = .03) of hazard RR_{BW} was seen in younger women (ages 30–49 years), but the observed values were generally greater than 1. Overall, the hazard RR_{BW} for women with ER− tumors was 1.30 (95% CI = 1.11 to 1.50). For women with ER+ tumors (Figure 4, B), the risk of breast cancer death was higher among black women than white women (hazard RR_{BW} > 1.0 for all age groups except for women older than 70 years at diagnosis in the years 1994, 1996, 2000, and 2003 [overall hazard RR_{BW} = 1.40; 95% CI = 1.13 to 1.67]). No statistically significant temporal trend was seen in the hazard RR_{BW} of the different age groups with ER+ tumors.

Finally, we investigated the RR_{BW} of the expected IBM constructed using observed race-specific parameters (ER expression and hazard rates of breast cancer death) and also under different counterfactual scenarios (Figure 5). The observed IBM among all black case subjects was twice as high as that among all white case subjects throughout the study period. Equalizing proportions of case subjects with ER+ and ER− breast cancer slightly reduced the IBM RR_{BW} from about 2.00 to approximately 1.75. In contrast, equalizing annual hazard rates eliminated the black-to-white racial disparity, that is, the IBM RR_{BW} fell from approximately 2.00 to close to 1.00. Finally, the IBM RR_{BW} was reversed (IBM RR_{BW} was approximately 0.90) after equalizing both the proportion of ER− and ER+ case subjects and annual hazard rates of breast cancer death. A sensitivity analysis demonstrated that the results were essentially unchanged if the data were stratified by all the categories of ER expression from Table 1 (Supplementary Figure 1, available online).

Discussion

In this study, we investigated aspects of the racial disparity in age-standardized breast cancer mortality rates that have been described as "a moral and ethical dilemma for our nation" (11). The gap between the breast cancer mortality rates in black women and white women emerged in the late 1970s and has continued to widen. Our analysis focused on the period since 1990, when ER status was first systematically recorded in the SEER database.

Throughout the period covered by our study (1990–2004), breast cancer mortality rates declined considerably for both black and white women, although the decline was slower in black women. During the same period, black-to-white incidence rate ratios remained relatively constant, and the age-specific incidence rates in black women were typically lower. Therefore, incidence trends alone cannot account for the widening disparity in breast cancer mortality.

In contrast, the hazard of breast cancer death was statistically significantly higher in black women compared with white women, irrespective of ER expression, and it persisted after adjustment for multiple tumor and demographic characteristics. Our counterfactual IBM analysis revealed that these differences in breast cancer prognosis could explain most of the disparity in breast cancer mortality in the United States. Perhaps surprisingly, however, a more modest contribution to the racial disparity can be attributed to the

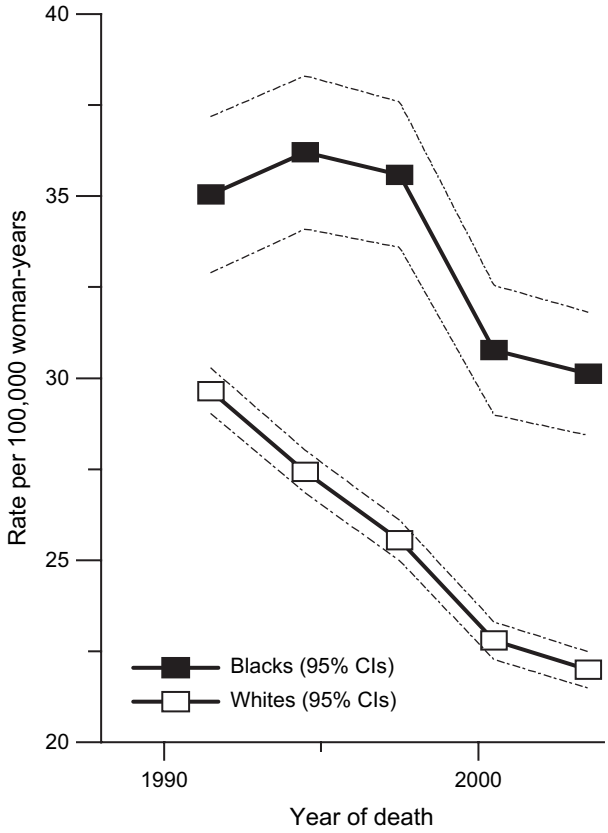

Figure 1. Age-standardized breast cancer mortality rates. Age-standardized breast cancer mortality rates in the National Cancer Institute's Surveillance, Epidemiology, and End Results 9 are plotted for black (**solid squares**) and white (**open squares**) women between the years 1990 and 2004 by 3-year period. **Dashed lines** indicate 95% confidence intervals (CIs).

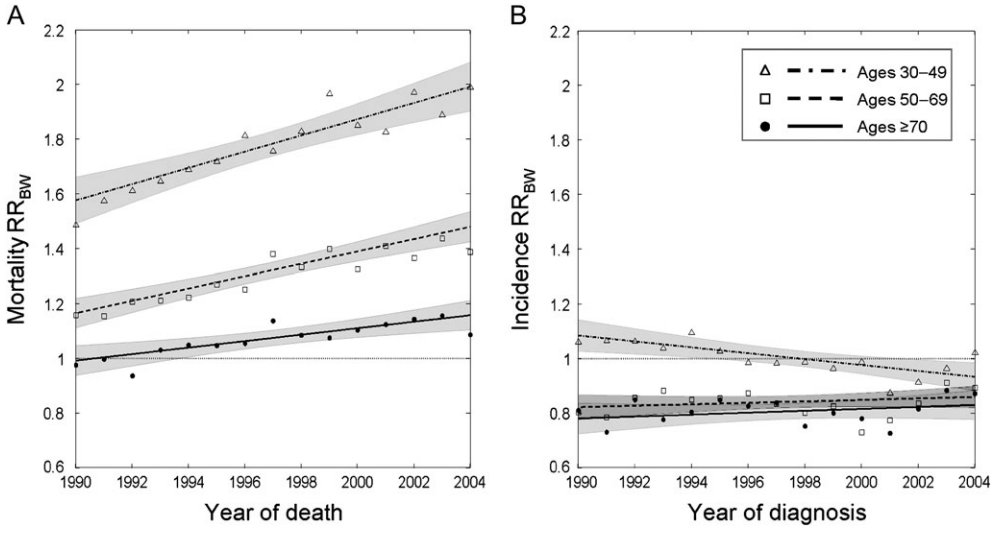

Figure 2. Black-to-white breast cancer mortality and incidence rate ratios (RRs_{BW}) for three age groups. **A**) Mortality RR_{BW}. **B**) Incidence RR_{BW}. Observed values (**dots**, age ≥70 years; **squares**, ages 50–69 years; and **triangles**, ages 30–49 years) are shown along with the corresponding fitted trends (**solid line**, **dashed line**, and **dot–dash line**, respectively) with 95% confidence intervals (**shaded areas**). **Broken black line** indicates an $RR_{BW} = 1$.

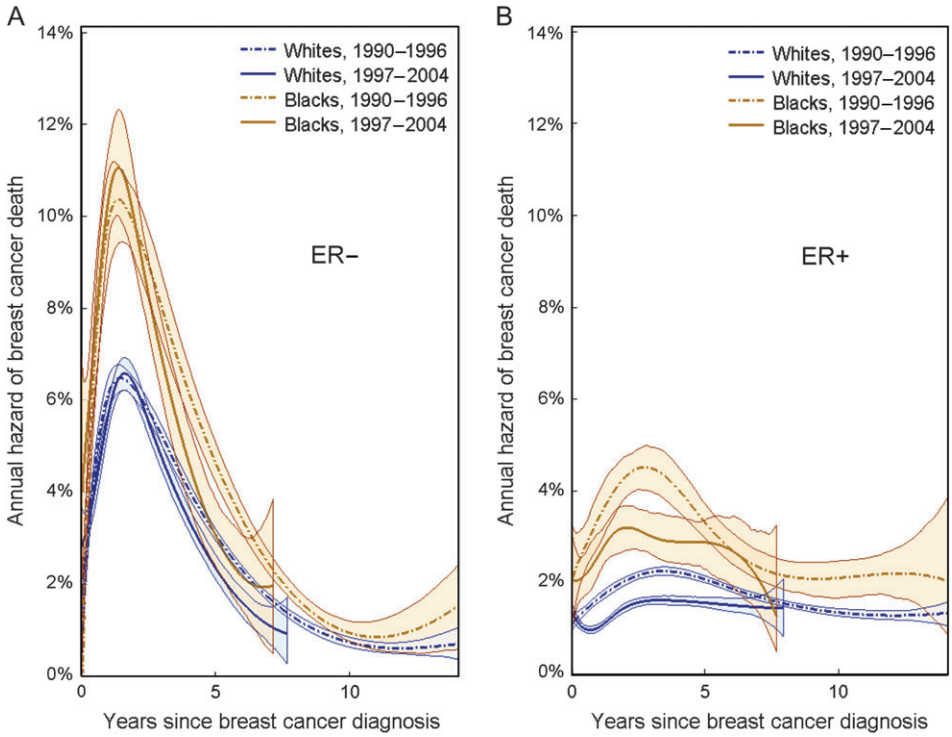

Figure 3. Annual hazard rates of breast cancer death (percentage of breast cancer dying per year among women living with the disease) are plotted against years since diagnosis for black women (**orange**) and white women (**blue**) for two calendar periods: 1990–1996 (**broken lines**) and 1997–2004 (**solid lines**). **A**) Hazard rates among case subjects with estrogen receptor–negative (ER−) tumors. **B**) Hazard rates among case subjects with estrogen receptor–positive (ER+) tumors.

tumor characteristics, which included a disproportionately higher incidence of ER− tumors (which are associated with a less favorable prognosis) among black women, and also a larger fraction for whom the ER status of the tumor was not determined or not documented in the medical record.

In several clinical trials, it was shown that black and white patients derived a similar benefit from adjuvant systemic therapy administered in accordance with tumor characteristics, such as ER status (24). Unfortunately, when equal efficacy can be demonstrated in the trial setting, this does not guarantee equal effectiveness in the population. Our study suggests that racial disparity in breast cancer mortality can only be eliminated when hazard rates of breast cancer death in the entire population (which partly reflect access to therapy) are matched in black and white women irrespective of ER expression.

Various factors have been suggested to contribute to increased hazard rates observed among black women diagnosed with breast cancer. Black women are less likely to have adequate insurance coverage, which may limit their access to therapies (25,26). A study that examined breast cancer survival trends in an equal-access health-care system suggests that access to health care alone cannot account for the widening racial disparity (27). In our study, even after adjusting for socioeconomic variables available in SEER, the hazard RR_{BW} remained greater than 1.0 (ie, higher hazard of breast cancer death among black women vs white women) in both ER− and ER+ diseases. Other socioeconomic factors such as education and cultural and behavioral characteristics have also been implicated as risk factors for breast cancer (8,28) and may also affect survival from this disease. Health-related factors that differ between the two ethnic groups,

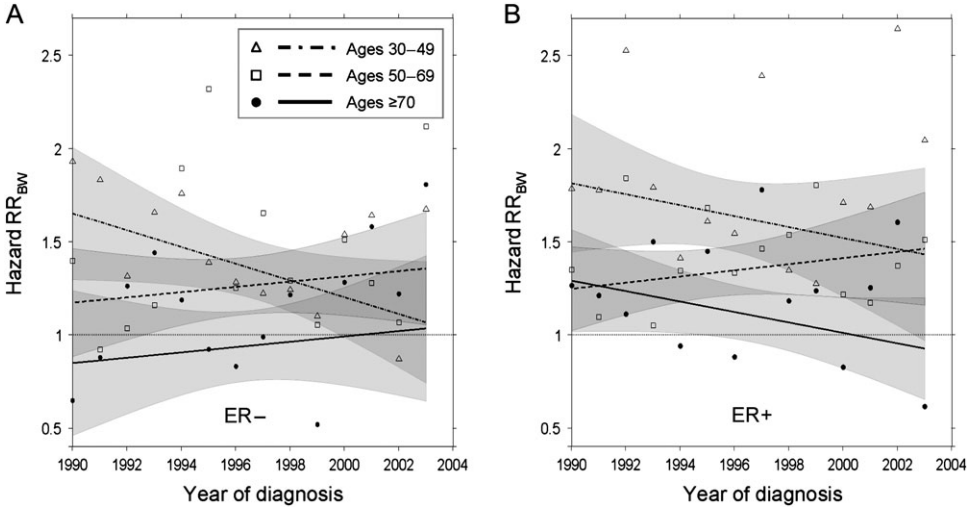

Figure 4. Black-to-white breast cancer hazard rate ratios (RRs_{BW}). Hazard RRs_{BW} are plotted for three age groups. **A**) Estrogen receptor–negative (ER−) tumors. **B**) Estrogen receptor–positive (ER+) tumors. In each panel, observed values (**dots**, ages ≥70 years; **squares**, ages 50–69 years; and **triangles**, ages 30–49 years) are shown along with the corresponding fitted trends (**solid line**, **dashed line**, and **dot–dash line**, respectively) with 95% confidence intervals (**shaded areas**). **Broken black line** indicates an $RR_{BW} = 1$.

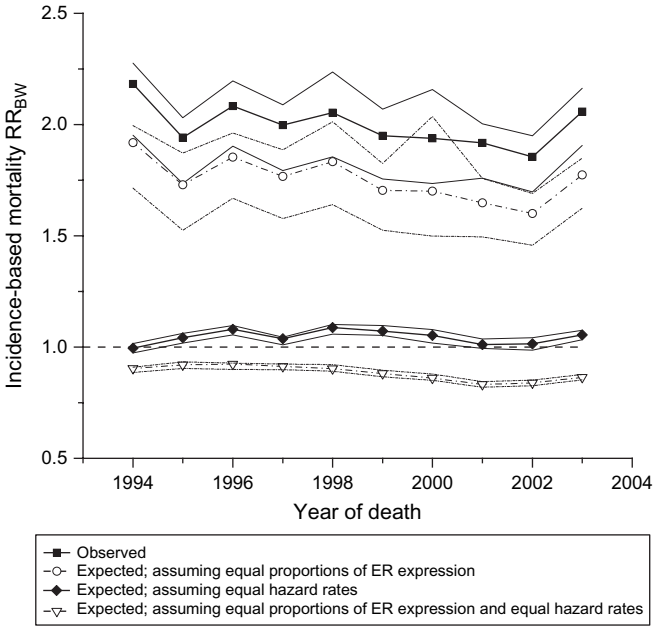

Figure 5. Black-to-white incidence–based mortality rate ratios (IBM RRs$_{BW}$). Black-to-white IBM RRs$_{BW}$ with 95% confidence intervals were calculated and plotted under four different scenarios: 1) observed IBM RRs$_{BW}$ (**solid squares**), 2) expected IBM RRs$_{BW}$ after equalizing the proportions of estrogen receptor–negative and estrogen receptor–positive (ER− and ER+) breast cancers in black women to the proportions in white women (**open circles**), 3) expected IBM RRs$_{BW}$ assuming that annual hazard rates for death from ER+ and ER− breast cancers in blacks were equal to the corresponding rates in whites (**solid diamonds**), and 4) expected IBM RRs$_{BW}$ after equalizing the proportions of ER− and ER+ breast cancers and annual hazard rates for death from ER+ and ER− breast cancers (**open triangles**).

such as obesity, may also play a role (29,30). Unfortunately, most of these factors are not yet captured by the SEER program at the individual level.

Our study has the usual limitations of descriptive epidemiology (ie, retrospective registry assessment, missing data, nonstandardized ER typing, and lack of individual-level risk factor data). In addition, the IBM calculations in this study pertained to a subcohort of women; essentially, the subcohort of women recently diagnosed with the disease. Thus, it does not include the experience of women who have been living with breast cancer for many years. Furthermore, the counterfactual analysis only illuminates population trends by indicating how much better things could be, but provides no specific information on how to ameliorate the mortality gap.

In conclusion, our results suggest that the widening black-to-white disparity in breast cancer mortality rates in the United States is largely driven by the consistently higher hazard of death among black women living with the disease, irrespective of tumor ER expression at diagnosis. It is also apparent that the greatest absolute difference in the hazard rates occurs during the first several years after diagnosis. These differences in hazard rates may reflect racial differences in response and access to innovations in breast cancer screening and treatment, as well as other biological and nonbiological factors. Hence, greater emphasis should be placed on identifying the reasons for these increased hazards among black women and on developing new therapeutic approaches to address the disparity.

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