Journal of the National Cancer Institute Monographs, 2023, **2023(62),** 178–187
https://doi.org/10.1093/jncimonographs/lgad023
Monograph

Population simulation modeling of disparities in US breast cancer mortality

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Abstract

Background: Populations of African American or Black women have persistently higher breast cancer mortality than the overall US population, despite having slightly lower age-adjusted incidence.

Methods: Three Cancer Intervention and Surveillance Modeling Network simulation teams modeled cancer mortality disparities between Black female populations and the overall US population. Model inputs used racial group–specific data from clinical trials, national registries, nationally representative surveys, and observational studies. Analyses began with cancer mortality in the overall population and sequentially replaced parameters for Black populations to quantify the percentage of modeled breast cancer morality disparities attributable to differences in demographics, incidence, access to screening and treatment, and variation in tumor biology and response to therapy.

Results: Results were similar across the 3 models. In 2019, racial differences in incidence and competing mortality accounted for a net –1% of mortality disparities, while tumor subtype and stage distributions accounted for a mean of 20% (range across models = 13%-24%), and screening accounted for a mean of 3% (range = 3%-4%) of the modeled mortality disparities. Treatment parameters accounted for the majority of modeled mortality disparities: mean = 17% (range = 16%-19%) for treatment initiation and mean = 61% (range = 57%-63%) for real-world effectiveness.

Conclusion: Our model results suggest that changes in policies that target improvements in treatment access could increase breast cancer equity. The findings also highlight that efforts must extend beyond policies targeting equity in treatment initiation to include high-quality treatment completion. This research will facilitate future modeling to test the effects of different specific policy changes on mortality disparities.

Breast cancer is the most common cancer among women in the United States (1). Improvements in screening and advances in molecular subtype-specific systemic therapy have led to overall declines in breast cancer mortality over the past 2 decades (2), but this progress has not been realized equally for all women. Stage-for-stage, self-identified African-American or Black women ("Black women") have persistently higher breast cancer mortality than all other racial and ethnic groups (3-5).

The observed excess breast cancer mortality experienced by Black women is likely to be a result of the effects of multiple factors, including systemic racism. *Systemic racism* is defined as individualized racism and the social policy and economic and health care structures affecting opportunities for access to and quality of screening (6) and downstream physiologic disruptions leading to increased cancer risk (7-13). Among women developing breast cancer, systemic racism can lead to reduced likelihood of timely

Received: May 18, 2023. **Revised:** July 13, 2023. **Accepted:** July 31, 2023

diagnosis or receiving full recommended treatment and survivorship care, leading to excess mortality (14-23). For example, Black women are less likely than other women to have access to newer early detection technologies, such as tomosynthesis, that can reduce false-positive recalls (24) and more likely to be affected by racially biased policies (25), such as redlining and segregation, that have been linked to lower breast cancer survival (26,27). Racial differences in competing mortality and the distribution of tumor subtypes also contribute to disparities in breast cancer mortality (28,29).

Unfortunately, it is not possible to quantitate the relative contributions of different factors to the inequity in cancer mortality using empirical studies because most data sources lack adequate follow-up from birth to death, do not include complete data on cancer screening and treatment, and lack adequate numbers of Black women (30). Population simulation modeling studies are useful because they can synthesize complex evidence from different sources for multiple cohorts in the US population followed over the entire life course.

In this study, 3 well-established Cancer Intervention and Surveillance Modeling Network (CISNET) models (31,32) were used to extend past work (33-35) to quantitate the contributions of racial group–specific demographics, breast cancer incidence, tumor biology, and current screening and treatment use to differences in US breast cancer mortality rates between populations of Black and all women (36). In these analyses, racial group was used as a proxy for the effects of systemic racism and did not represent ancestry. The results are intended to highlight leverage points for increasing racial equity in breast cancer mortality.

Methods

We used model D (Dana-Farber Cancer Institute, Boston, MA), model GE (Georgetown University Medical Center, Washington, DC, and Albert Einstein College of Medicine, Bronx, NY), and model W (University of Wisconsin-Madison, Madison, WI, and Harvard Medical School, Boston, MA) for this study. The models have been described in detail elsewhere (31,32,37). Briefly, model D is an analytical model that captures screening benefits through stage shifts. Model GE uses a continuous-time, event-driven microsimulation that models natural history phenomenologically, relying on dates, stage, and time of detection as well as survival by molecular subtype. Model W has a tumor growth model and assumes a portion of small ductal carcinoma in situ and early-staged cancers to be nonprogressive. The University of Wisconsin Institutional Review Board, the site of the CISNET Breast Cancer Coordinating Center at the time of this study, considered this research human subjects exempt because of the use of publicly available, deidentified data.

Population

We modeled the life course of multiple US birth cohorts of the Black female population compared with that of the overall US female population during the period 1975 to 2019.

Model overview

The models started with estimates of breast cancer incidence and estrogen receptor/ERBB-2–specific survival trends over time in the absence of screening or adjuvant treatment (2,31,32,38,39). We assumed that this underlying subtype-specific cancer survival was the same across racial groups, conditioned on stage and age (40).

Observed screening and treatment patterns were then overlayed to simulate an effect of screen-detection based on stage shift (models D and GE) or tumor size (model W), with detectability based on the sensitivity of mammography. The 3 models made different assumptions about the proportion of ductal carcinoma in situ cases that progressed to invasive cancer. Tumor subtype-, age-, and stage-specific treatment reduced the hazard of breast cancer death (models D and GE) or the likelihood of cure during the lead time (model W). Women could have died of breast cancer or other causes.

Model input parameters

The models shared a set of common input parameters (Table 1). Age-specific other-cause mortality (41) was derived from racial group–specific age-period-cohort models using data from US lifetables and Centers for Disease Control and Prevention mortality data (42). Although the models count all events, from birth to death, as in our prior work, we focus on reporting the population of those aged 30 to 79 years because breast cancer is rare before age 30 and single-year data for women older than 84 years of age are unavailable (2,39). We exclude male breast cancer.

Incidence

Breast cancer incidence in the absence of screening was modeled by racial group based on earlier age-period-cohort models using Surveillance, Epidemiology, and End Results (SEER) data before 1980 (43) and incidence rate ratios by racial group to update trends over time (43,44).

Screening

Screening dissemination was estimated separately by racial group by birth cohort and calendar year, extending methods in our prior research to the year 2019 (45,46). Briefly, the age at first screen was based on data from the National Health and Interview Survey. For women reporting a first mammogram before 40 years of age, a portion were assumed to be diagnostic and so were removed from the estimate of screening use based on data from the Breast Cancer Surveillance Consortium (BCSC); women 40 years of age and older were assumed to be undergoing screening (47). By 2019, 95% and 94.5% of women overall and Black women born in 1948, respectively, had had a first mammogram.

Subsequent screening frequency after the first mammogram was based on data from the BCSC between 1994 and 2012 for those getting mammograms at approximately 12- to 18-month intervals, 19- to 30-month intervals, or more than 30-month intervals. The distributions of time between mammograms within each of these groups were sampled to obtain a specific screening date for each simulated woman (45,48). We assumed that the patterns of screening use by racial group observed through 2012 continued through 2019.

In terms of the screening modality, we assumed that plain-film mammography was used from the 1980s to 2005. From 2006 to before 2011, screening was a mix of the rapidly decreasing use of plain-film mammography and increasing use of digital mammography. From 2011 onwards, all examinations were mainly digital, increasing to nearly all digital based on BCSC data and the US Food and Drug Administration Mammography Quality Standards Act and Program (49,50). For simplicity, digital mammography includes the use of digital breast tomosynthesis in later years because evidence suggests that they have similar sensitivity and impact on mortality (51).

Table 1. Racial group–specific model input parameters[a]

Parameter	Description	Source
Births	Birth cohorts, 1890-2000, by racial group	US Vital Reports; SEER*Stat
Incidence	Race-specific age period cohort model	SEER
DCIS	Proportion progressive	Model D
Mammogram use: first screen	First screen, by calendar year, birth cohort, and racial group (excludes diagnostic mammograms)	National Health Institute Survey; BCSC
Mammogram use: screening group patterns of ongoing use after first screen	By age group (70-79 y), racial group, and time period (excludes diagnostic mammograms)	BCSC
Mammogram use: distribution of time interval between screens	Times within each screening group; assumes the distribution within group is the same for Black and all women	BCSC
Mammogram modality	Plain film and digital, by calendar year and race	BCSC, FDA
Mammogram sensitivity	Age group–specific performance rates for plain film and digital for first and later exams, by screening group (assumed equal by racial group)	BCSC data
Sojourn time	Calibrated parameter, by age and subtype	Derived
Stage at diagnosis in the absence of screening	Clinically detected cases, by age and racial group	BCSC data
Screen-detected breast cancer stage distribution	Screen-detected cases, by age and racial group	BCSC data
Estrogen receptor/ERBB2 distribution	Estrogen receptor/ERBB2, by age, stage, racial group, and mode of detection	BCSC
Survival in the absence of screening and systemic treatment, by molecular subtype	SEER	Derived
Treatment initiation/dissemination	Assumes Black women are 22% 15% less likely to receive multiagent chemotherapy and endocrine therapy, respectively	SEER, NCCN, expert opinion
Treatment efficacy	Reduction in breast cancer death, by age, stage, and estrogen receptor/ERBB2 status	Oxford overview; expert opinion
Treatment efficacy decrements	Reflects real-world differences in treatment delivery, Black women only	NCCN
Other mortality	Age-specific, racial group–specific, and other-cause mortality	CDC Wonder, Human Mortality Database

[a] BCSC = Breast Cancer Surveillance consortium; CDC = Centers for Disease Control and Prevention; D = Dana-Farber Cancer Institute model; DCIS = ductal carcinoma in situ; FDA = US Food and Drug Administration; NCCN = National Comprehensive Cancer Network; SEER = Surveillance, Epidemiology, and End Results.

Screening performance was based on period, time between screens for the screening frequency groups, and considering age and screening modality, with observed increases in the performance of digital mammography over time (personal communication, Ellen O'Meara, BCSC). We used the same screening performance data for Black and all women because there were no observed significant or clinically meaningful differences by racial group (49).

Tumor subtype, sojourn time, stage

Women were assigned a tumor subtype based on age and racial group, using data from the BCSC (49). Racial group differences in subtype could result in differences in sojourn time. In models D and GE, each molecular subtype has an underlying preclinical sojourn time distribution based on our past work; model W assigns a subtype at detection (2,39). Stage (American Joint Committee on Cancer, version 6, or SEER stage) was considered based on racial group, age group (<50 years, ≥50 years), lead time, and whether the tumor was diagnosed by screening or clinical detection (49). Clinical detection includes any non–screen-detected cancer (ie, interval or symptomatic presentation).

Treatment

Initiation of adjuvant therapy was conditional on age, diagnosis year, stage, and tumor subtype. Patterns of treatment initiation among all women from 1975 to 1996 were estimated using data about treatment use from the National Cancer Institute's (NCI's) Patterns of Care (POC) studies (52). These data indicated that compared with all women, Black women were 22% and 15% less likely to receive multiagent chemotherapy and hormone therapy, respectively (33). These differences were applied to the adjuvant treatment initiation curves for all women to derive curves for Black women. For 1997-2012, we used data from patients presenting at National Comprehensive Cancer Network member sites, as previously reported (2).

We used data from the Oxford Overview Meta-analyses to estimate treatment efficacy (36,53). These data were updated to reflect current efficacy based on recent clinical trial data and expert opinion (49,54-58). All adjuvant effects assume the use of local therapy (surgery and radiation therapy).

Because there are widely reported racial group differences in time from diagnosis to treatment initiation as well as nonstandard regimens, reductions in dose, and numbers of treatment cycles per year completed (59-61), we used National Comprehensive Cancer Network data reported by Warner and colleagues (22) to estimate a real-world decrement in the effectiveness of treatment based on systemic racism or other factors by applying a decrease in the efficacy seen in clinical trials for Black vs all women.

Analysis

We began analyses by comparing model outputs to observed SEER incidence, stage, and mortality from 1975 to 2019 for breast cancer for populations of all women and Black women aged 30 to

79 years. Rates were depicted as rolling 5-year averages of individual years (ie, the average for a given year was based on the rates in the 2 years before and 2 years after the actual year, then the average of these 5 values). To remove effects of any differences in age composition of cohorts over time and racial group, all rates were age-adjusted to the US female population in 2000.

Analyses of model-estimated mortality

We began by simulating 2019 age-adjusted mortality rates for populations of all women. Next, we sequentially substituted parameters for populations of Black women into the model for all women to identify parameters that drive the mortality differences in 2019: 1) demography (birth, competing-cause death rates), 2) breast cancer incidence in the absence of screening, 3) components of tumor natural history (estrogen receptor/ERBB2 distribution, sojourn time, and stage in the absence of screening), 4) screening use and performance as well as stage among screened women, and 5) initiation of treatment and treatment effectiveness using decremented effects for Black women. After each parameter or parameter set substitution, we computed the percentage of the breast cancer mortality disparities experienced by populations of Black women that was explained by the parameters. This was accomplished by calculating the difference in modeled mortality between the Black and overall population after each parameter substitution; this difference was then divided by the difference in modeled mortality between the full Black and overall population models to generate the percentage of mortality explained by that parameter or parameter set. We present the results as model means and range across models.

Uncertainty

The models take different approaches to modeling unobservable parameters, so differences in model results provide 1 estimate of uncertainty based on model structure (2,31,32,48).

Results

Model validation

After a rise in age-adjusted breast cancer incidence in the late 1990s, rates decreased for all women and for Black women. These trends were accurately replicated by the models for women in both racial groups, with modeled incidence and mortality rates within ±12% and ±16%, respectively, of observed rates over time (median ±2% and ±4%) (Figure 1).

The observed stage distribution at diagnosis for the period 2015-2019 was more favorable for all women vs Black women, and this trend was seen in the model-projected stage distributions (Supplementary Figure 1, available online). The model-predicted breast cancer mortality rates were similar to observed rates for both racial groups (Figure 2).

Factors contributing to mortality in 2019

The results seen for mortality rates after each step of the sequential substitution of parameters for Black women into the models for all women were similar across the 3 models (Table 2). The results indicated that because incidence was slightly lower for Black women than for all women, there would be a mean 6% reduction in the mortality rate for Black women. Considering competing mortality, modeled mortality would have been a mean of 5% (range across models = 0%-9%) higher in Black women (vs all women), for a net difference of –1% for these 2 parameters (Figure 3). Racial differences in tumor subtype and stage distributions in the absence of screening accounted for a mean of 20% (range across models = 13%-24%) of the mortality disparity in Black women. Differences in screening use had a small impact on the mortality disparity in Black women (meanv3% [range = 3%-4%]). Treatment parameters accounted for the majority of modeled mortality disparities for Black women: mean = 17% (range = 16%-19%) for initiation of systemic therapy and mean = 61% (range = 57%-63%) for effectiveness in real-world settings.

Discussion

This collaborative modeling study used established simulation models to quantify the contributions of current patterns in cancer and cancer care on racial disparities in US breast cancer mortality. Overall, the modeled breast cancer incidence and mortality accurately replicated observed trends among populations of all women and Black women. The models consistently indicated that variations in treatment initiation and real-world effectiveness accounted for the largest percentage of the modeled mortality disparity among Black women, with most of this impact related to effectiveness. Screening use and tumor subtype and stage accounted for a smaller percentage of the modeled mortality differences.

The finding that the majority of modeled racial disparities were related to treatment use and effectiveness is similar to our past results, which showed that over time, treatment advances have accounted for an increasing proportion of the overall declines in US breast cancer mortality (2,33). There is evidence, however, that Black women have not been able to benefit fully from the progress in therapy, with delays in and lower rates of treatment initiation, dose reductions and delays, and lower rates of treatment completion than for all women (22,62). These observations are likely to represent examples of the downstream effects of various dimensions of systemic racism on cancer therapy, reflecting limitations in access based on racial segregation, inadequate representation in clinical trials, not having adequate insurance to cover all aspects of costs, lack of community resources, interpersonal racism experienced when receiving care, or the receipt of non–guideline-concordant care (9,30,63). In addition, there may be racial differences in tumor biology that effect responses to treatment (30).

When Black women receive optimal, trusted communication regarding treatments such as systemic therapy and care with racially concordant health-care professionals, they have been found to have higher treatment uptake, suggesting that disparities in receipt of therapy are modifiable (64,65).

Our modeling of screening was robust in employing current data on mammography use and performance, but screening accounted for a small proportion of the mortality disparity in Black and all women. This result is likely because mammogram use is similar between Black women and all women, with some data sources citing higher rates of mammography use in Black women. Despite similar use, however, evidence shows that Black women may not have access to similar screening quality, as evidenced by data showing that they are less likely to access newer technologies such as tomosynthesis that avoid false-positive recalls, less likely be screened at facilities with onsite diagnostic follow-up, and more likely to experience delays after abnormal screens—all potential effects of systemic racism in the health-care system.

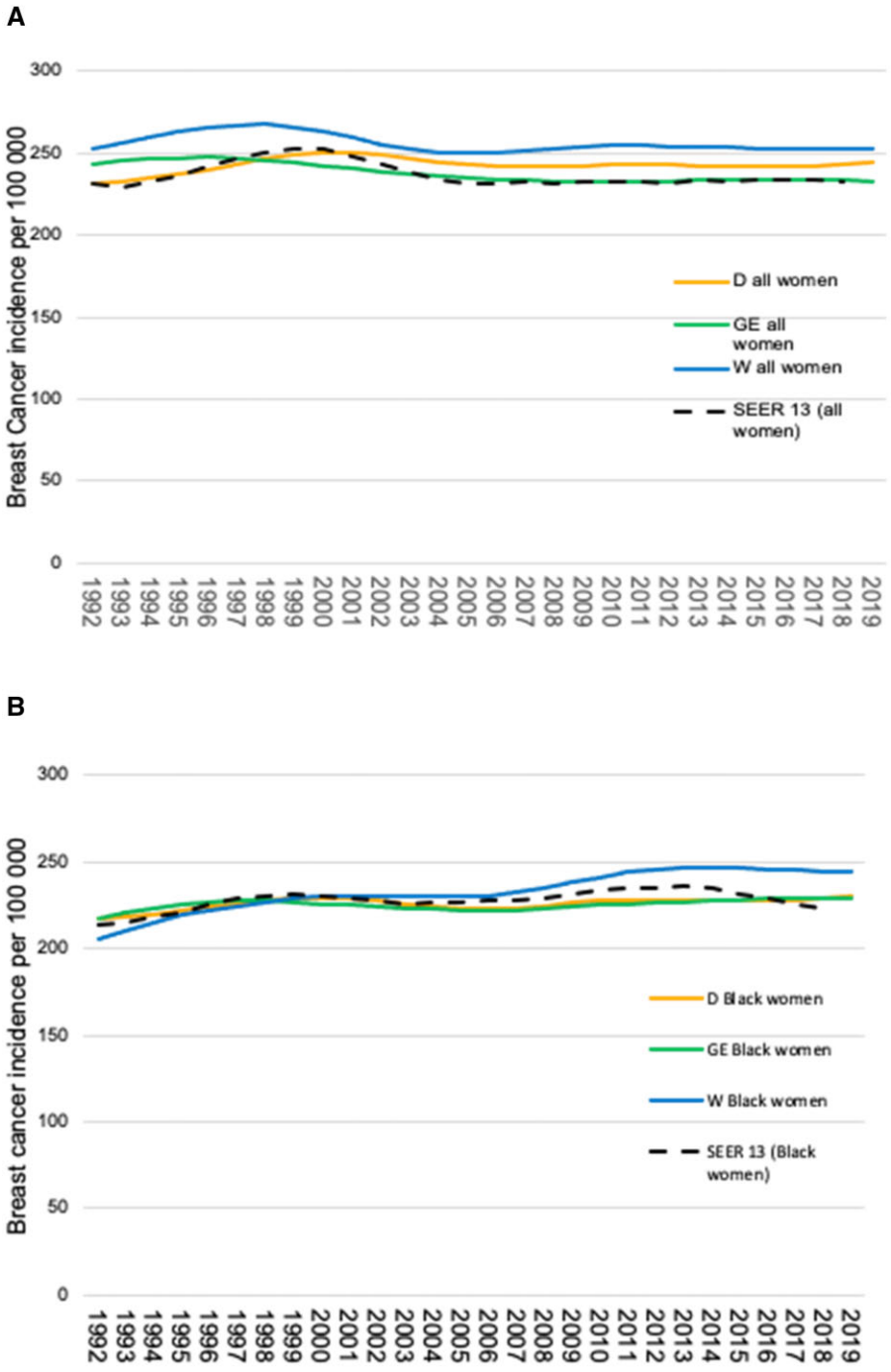

Figure 1. Modeled vs observed breast cancer incidence rate per 100 000 women, by model. **A**) All women. **B**) Black women. Modeled invasive and ductal carcinoma in situ incidence rates per 100 000 for women aged 30 to 79 years, by year, model, and racial group; rates are 5-rolling rolling averages. **Solid line** is the rate reported to SEER 13. D = Dana-Farber Cancer Institute model; GE = Georgetown University Medical Center and Albert Einstein College of Medicine model; SEER = Surveillance, Epidemiology, and End Results; W = University of Wisconsin-Madison model.

In this analysis, we did not explicitly consider documented diagnostic delays after an abnormal screen (66). Past modeling analyses suggest that delays can result in less favorable stage (67). The models only captured delays that resulted in a full stage shift or change in tumor size from curable to noncurable (68,69). Because stage and subtype accounted for about one-fifth of the modeled mortality in Black women, it is possible that delays or poor-quality screening are being captured in these parameters. Modeling racial group–specific diagnostic delays and impact on stage by tumor subtype would be important to explore in future modeling efforts to test strategies to reduce disparities and increase equity.

The modeled mortality was generally close to the mortality rates reported to SEER, while our past modeling studies were only able to explain about 50% of the observed racial differences in mortality (33,34). The differences between our current and past results reflect updates to include subtypes based on hormone receptor and ERBB2 status (vs hormone receptor only); use of

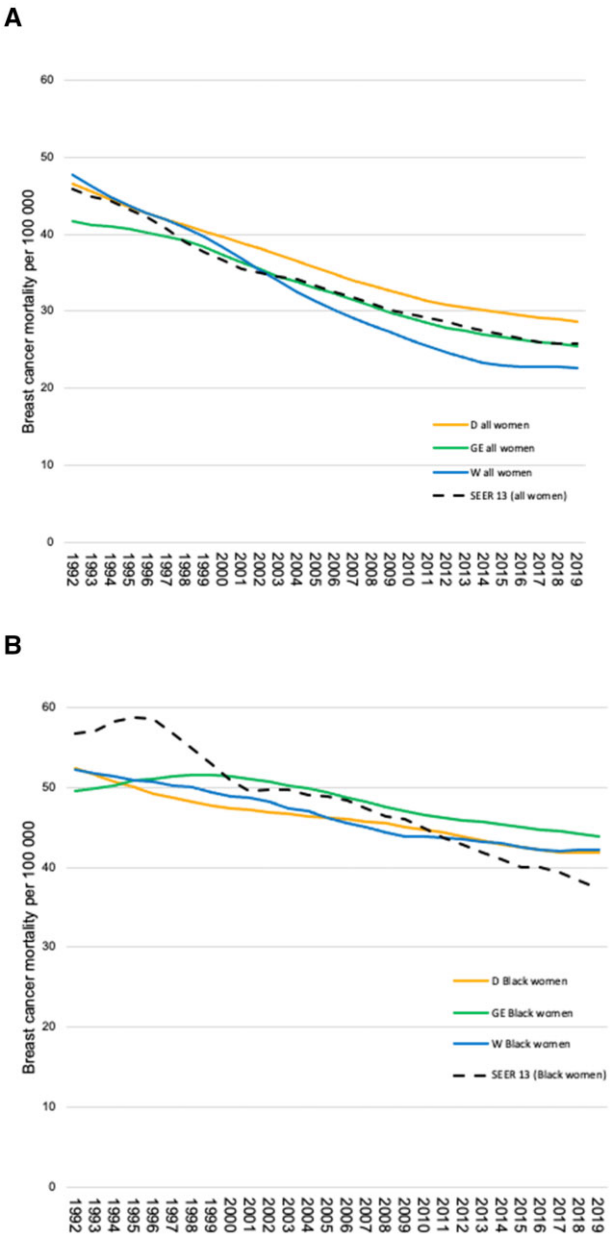

Figure 2. Modeled vs observed breast cancer mortality rate per 100 000 women, by model. **A**) All women. **B**) Black women. Modeled breast cancer mortality rates per 100 000 women aged 30 to 79 years, by year, model, and racial group; rates are 5-rolling rolling averages. **Black dashed line** is the rate reported to SEER 13. D = Dana-Farber Cancer Institute model; GE = Georgetown University Medical Center and Albert Einstein College of Medicine model; SEER = Surveillance, Epidemiology, and End Results; W = University of Wisconsin-Madison model.

digital mammography, with its higher sensitivity than film mammography; and incorporation of decrements in treatment initiation and effects. Our analyses ended in 2019 and were not confounded by the effects of the COVID-19 pandemic. During the pandemic, there were observed differential economic and health impacts on racial and socioeconomic groups, including reduced use of medical care and delays in cancer screening and treatment (70,71). These impacts on access to care could potentially widen the disadvantage Black women experience in receipt of care even after diagnosis, increasing future racial mortality disparities.

This study included 3 well-established independent breast cancer models using input parameters from large national registries and clinical trials. Several caveats should be considered in evaluating our results, however. First, with the exception of tumor biology and response to treatment, we used racial group as a proxy for the potential impact of factors related to systemic racism because they may affect model components related to cancer risk and care. Racial group, however, does not fully capture the broad impacts of racism on cancer outcomes (9). Incorporating better measures of structural, interpersonal, and internalized racism into model parameters will be important in future efforts to identify broader leverage points for achieving breast cancer equity (9,72). In analyses looking at systemic racism, Hoskins and colleagues found that neighborhood disadvantage and insurance accounted for one-fifth of the excess mortality seen for Black women in the SEER registry, a comparable magnitude of effect of oncotype scores on mortality (23,73). Those SEER data may provide an approach to modeling interactions of measures of systemic racism in future modeling efforts. Next, although conclusions about the contributions of different aspects of cancer care to mortality in Black women were similar across the 3 models, there was some model variability. The main model differences were related to stage, subtype, and sojourn time because each model has a different approach to capturing these natural history components. In model GE, the observed stage distributions of screen-detected and clinically detected tumors are used to characterize the rapidity of tumor progression, and stage shift is also the principal mechanism for screening to reduce mortality. Model W portrays these parameters integrated with treatment and survival because they include a cure fraction based on tumor size, which depends on tumor growth rate. Another limit of our analysis was that our conclusions about the impact of treatment factors vs other factors are a result of estimated use and effectiveness of therapy among Black women from older patterns of care seen in SEER and academic centers, but there are inconsistent results in some current studies (22,23,74). Thus, it is possible that we overestimated or underestimated the actual contribution of systemic therapy on racial disparities. Other limits, including the lack of modeling of tumor grade and gene expression profiles, which are markers of tumor aggressiveness, are likely to have led to underestimates of the effects of systemic racism on survival because Black women have been shown to have more aggressive tumors, even within tumor subtypes (23,73). We also did not assess racial differences in the use of regimens for treatment of distant metastases—an important future direction.

Overall, our modeling results suggest that all points in the cancer care process, from screening to treatment, influence breast cancer disparities among Black women, with the largest contribution arising from the receipt of effective therapy. Although every avenue should be pursued to improve health equity, increasing access to complete, effective therapy is particularly essential because of its impact on disparities. Fortunately, deficits in delivery of the most effective therapy is modifiable. Future modeling research will be important to test the effects of different policy changes (eg, Medicaid expansion) and greater inclusion of Black women in clinical trials to enhance generalizability of treatment effects. Other important future directions include development and testing of the

Table 2. Observed and modeled mortality rates, by model and racial group, 2019, for women aged 30 to 79 years

	Observed mortality	Modeled parmeters[a]							
	SEER: all women	All	Demography	Demography, incidence	Demography, incidence, subtype, sojourn time, stage	Demography, incidence, subtype, sojourn time, stage, screening	Demography, incidence, subtype, sojourn time, stage, screening, treatment use	Demography, incidence, subtype, sojourn time, stage, screening, treatment use, treatment effects[b]	SEER: Black women
Mortality per 100 000 women	26.0	—	—	—	—	—	—	—	39.4
Model									
D	—	29.2	30.0	29.1	32.0	32.6	34.7	41.9	—
GE	—	26.0	26.0	25.0	29.5	30.1	33.2	44.5	—
W	—	22.8	24.5	23.1	25.6	26.2	29.9	42.1	—

[a] The models begin with all input parameters for the overall US population ("all women") and sequentially substitute in parameters for Black women. D = Dana-Farber Cancer Institute model; GE = Georgetown University Medical Center and Albert Einstein College of Medicine model; W = University of Wisconsin-Madison model.
[b] The final column is the full model for populations of Black women.

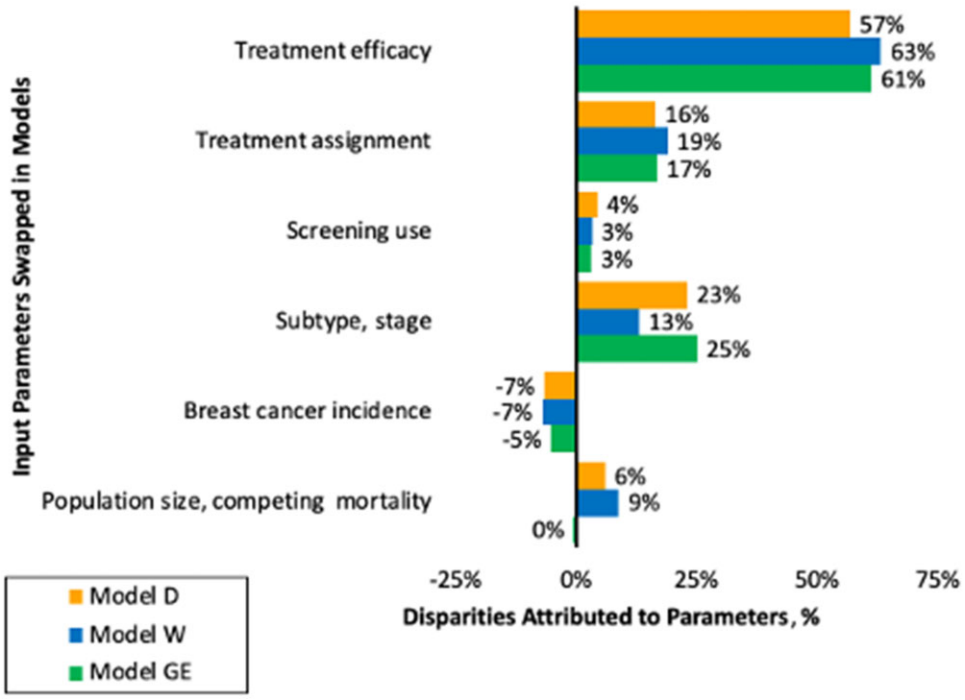

Figure 3. Percentage of modeled mortality for Black women explained by each set of parameter inputs, by model. The data in this figure were generated using several steps. First, mortality was modeled for each population using racial group–specific data. Next, the overall difference in modeled mortality between the Black and overall populations was calculated. Then, starting with the overall US population, parameters for the Black population were sequentially substituted into the overall population model 1 by 1, and the resulting mortality rates were generated at each step (see Table 2). The difference between the modeled mortality in each step and the mortality in the overall population model was then calculated. That latter difference was divided by the overall difference in modeled mortality between the Black and overall populations to generate the percentages summarized in the figure. D = Dana-Farber Cancer Institute model; GE = Georgetown University Medical Center and Albert Einstein College of Medicine model; W = University of Wisconsin-Madison model.

effects of multidimensional interventions to combat the effects of systemic racism on cancer mortality, including structural solutions such as mandated insurance programs, training to reduce interpersonal racism among health-care professionals, and increased numbers of oncologists from minority populations (9,30).

Data availability

Data for model input parameters are available to external groups through a data use agreement, a collaborative agreement, or other mechanisms consistent with CISNET, BCSC, and NIH policy. Model code is available through collaboration.

Author contributions

Jeanne S. Mandelblatt, MD, MPH (Conceptualization; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Supervision; Writing—original draft; Writing—review & editing), Clyde Schechter, MD, MA (Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Validation; Writing—original draft; Writing—review & editing), Natasha Stout, PhD (Formal analysis; Investigation; Methodology; Writing—original draft; Writing—review & editing), Hui Huang, PhD (Data curation; Formal analysis; Methodology; Writing—original draft; Writing—review & editing), Sarah Stein, PhD (Conceptualization; Data curation; Formal analysis; Methodology; Writing—original draft; Writing—review & editing), Christina Hunter Chapman, MD, MS (Methodology; Writing—original draft; Writing—review & editing), Amy Trentham-Dietz, PhD (Conceptualization; Funding acquisition; Project administration; Writing—original draft; Writing—review & editing), Jinani Jayasekera, PhD (Methodology; Writing—original draft; Writing—review & editing), Ronald Gangnon, PhD (Data curation; Methodology; Writing—original draft; Writing—review & editing), John Hampton, MS (Data curation; Formal analysis; Methodology; Writing—original draft; Writing—review & editing), Linn Abraham, MS (Data curation; Formal analysis; Methodology; Writing—original draft; Writing—review & editing), Ellen O'Meara, PhD (Data curation; Formal analysis; Methodology; Writing—original draft; Writing—review & editing), Vanessa Sheppard, PhD (Conceptualization; Writing—original draft; Writing—review & editing), Sandra Lee, ScD (Data curation; Formal analysis; Funding acquisition; Methodology; Project administration; Writing—original draft; Writing—review & editing).

Funding

This work was supported by the National Institutes of Health (NIH) under NCI grant No. U01 CA253911. This research was also supported in part by the NIH under NCI grants No. R35CA197289, No. R35CA283926, and No. UO1 CA199218 and the NIH under National Institute on Aging grant No. R21AG075008 to J.S.M.; a Georgetown University Lombardi Cancer Center Support grant (P30CA051008) for a pilot award to J.J.; and NIH under NCI grant No. P30CA014520 to A.T.D.. J.J. was supported in part by the Division of Intramural Research at the National Institute on Minority Health and Health Disparities of the NIH and the NIH Distinguished Scholars Program.

BCSC data collection and sharing were supported by the NCI-funded BCSC (P01CA154292; http://www.bcsc-research.org/).

The funding sources had no role in study conduct. The views, statements, and opinions in this publication are solely the responsibility of the authors and do not necessarily represent the views of the NIH or the US Department of Veterans Affairs. Opinions and comments expressed in this article belong to the authors and do not necessarily reflect those of the US government, US Department of Health and Human Services, the NIH, or the National Institute on Minority Health and Health Disparities.

Monograph sponsorship

This article appears as part of the monograph "Reducing Disparities to Achieve Cancer Health Equity: Using Simulation Modeling to Inform Policy and Practice Change," sponsored by the National Cancer Institute, National Institutes of Health ([Comparative Modeling of Precision Breast Cancer Control Across the Translational Continuum; 3 U01 CA253911-03S2]).

Conflicts of interest

The authors declare no potential conflicts of interest.

Acknowledgments

Role of the funder: The study sponsor did not have any role in the design of the study, the collection, analysis, and interpretation of the data, the writing of the manuscript, or the decision to submit the manuscript for publication.

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