Cancer Causes Control (2007) 18:323–333
DOI 10.1007/s10552-006-0102-y

ORIGINAL PAPER

The black:white disparity in breast cancer mortality: the example of Chicago

Jocelyn Hirschman · Steven Whitman · David Ansell

Received: 19 August 2006 / Accepted: 2 December 2006 / Published online: 6 February 2007

Abstract
Objective The black:white disparity in breast cancer mortality has been increasing in the U.S. In order to gain insight into this disparity in Chicago, we examined mortality data together with other important measures associated with breast cancer.
Methods Trends in black:white female breast cancer mortality, incidence, stage at diagnosis, and mammography screening in Chicago were examined using data from the Illinois State Cancer Registry, Illinois Department of Public Health Vital Records, and the Illinois Behavioral Risk Factor Surveillance System.
Results The breast cancer mortality rate for black women in Chicago for 1999–2003 was 49% higher than that of white women, but the disparity is a recent phenomenon that is increasing rapidly. In 2003 the black rate was 68% higher than the white rate. Mortality rates were similar in the 1980's and only started to diverge in the 1990's as a result of a sharp improvement in mortality among white women contrasted with no improvement for black women. This lack of progress for black women is perplexing given that self-reported mammography screening rates have been the same for blacks and whites in Chicago since at least 1996 and that the early detection of breast cancer for black women has been increasing.
Conclusions There has been no improvement in mortality from breast cancer for black women in Chicago in 23 years. This study, along with a review of the literature, lends support to the hypothesis that the disparities in breast cancer mortality are due to differential access to mammography, differential quality in mammography, and differential access to treatment for breast cancer. Fortunately, all three are amenable to intervention, which would help ameliorate this unacceptable disparity.

Keywords Breast cancer · Racial and ethnic disparities · Mammography · Stage

J. Hirschman (✉) · S. Whitman
Sinai Urban Health Institute, Sinai Health System, Mount Sinai Hospital, Room K430, 1500 South California Avenue, Chicago, IL 60608, USA
e-mail: hirj@sinai.org

D. Ansell
Rush University Medical Center, Chicago, IL, USA

Introduction

Breast cancer is the most commonly occurring cancer among women, causing more deaths than any other cancer except for that of the lung [1, 2]. Despite the fact that the Healthy People Initiative, in place for almost three decades, has been calling for the reduction [3] and elimination [4] of health disparities, there are black:white racial disparities in almost every step of the breast cancer process: from detection to treatment to survival [5–8].

Recent reports from the National Center for Health Statistics have documented a substantial black:white disparity in breast cancer mortality for the United States, expanding from a rate ratio of near unity in 1980 to 1.37 in 2003 [9]. An analysis of black:white disparities for many health indicators showed an even larger increase in the disparity of breast cancer mortality in Chicago between 1990 and 1998 [10].

Such data raise the important question about why the black:white disparity in breast cancer mortality is increasing at a time when the nation is striving to decrease disparities. For example, eliminating the breast cancer mortality disparity is one of the six areas selected for special concentration in the Healthy People 2010 pursuits [11] and the National Cancer Institute has named Overcoming Cancer Disparities as one of its 2015 Challenge Goals [12].

The overarching perspective of this analysis is that this question about mortality cannot be answered in isolation from other important breast cancer variables like mammography screening and stage at diagnosis. Chicago, which was found in the past to suffer from a substantial black:white disparity in breast cancer mortality [10] and which has a large number of both black and white women, is a logical locale for assembling and analyzing available data in an effort to gain insight into this disparity. To our knowledge no such analysis has ever been published to date for any local area, like a city although one comprehensive state analysis has appeared [13].

This profile thus presents the trends in screening, incidence, stage of diagnosis, and mortality from breast cancer. We hypothesize that analyzing all of these data as part of the same framework will allow us to delineate possible explanations for the black:white breast cancer mortality disparity, suggest interventions for improved detection and treatment of breast cancer and, eventually, allow us to eliminate disparities in this area.

Methods

According to the 2000 Census, Chicago is the third largest city in the United States with almost 3,000,000 people, of whom 16% are non-Hispanic white females and 20% are non-Hispanic black females [14]. To examine the incidence, stage of diagnosis, mortality, and screening of female breast cancer in Chicago, we used the following three data sources: Illinois State Cancer Registry, Illinois Department of Public Health Vital Records tapes, and the Illinois Behavioral Risk Factor Surveillance System.

Data sources

The Illinois State Cancer Registry (ISCR) was employed to analyze female breast cancers diagnosed between 1986 and 2002 in Chicago. ISCR is the population-based tumor registry for the State of Illinois and has had an estimated 88% statewide coverage since 1986 and greater than 97% coverage since 1994 [15]. Cancers in the ISCR are coded using ICD-O-2 (1986 through 2000) and ICD-O-3 (2001 and 2002) [16, 17]. Tumors in the registry are assigned a stage of disease code (in situ, localized, regional, and distant) [18]. Consistent with national and state methodology, female breast cancer counts, and rates in our analyses include only localized, regional, and distant-staged disease (i.e., invasive cancers). In situ cancers, when discussed, are presented separately.

To analyze female breast cancer mortality between 1980 and 2003 in Chicago, vital statistics data were obtained from the Illinois Department of Public Health Vital Records tapes (death files). Breast cancer deaths were identified using the ICD-9 (1980–1998) and ICD-10 (1999–2003) codes for ''malignant neoplasm of the breast'' [19, 20].

Mammography screening proportions (1996–2002) for women over 40 years of age were determined using Chicago data from the Illinois Behavioral Risk Factor Surveillance System (BRFSS). Details regarding the methodology of the survey are available elsewhere [21].

All data were provided to us without any personal identifying information.

Statistical analysis

Incidence and mortality rates were directly age-adjusted to the 2000 U.S. standard population and expressed as the number of cases or deaths per 100,000 population. Exponential interpolation between 1980, 1990, and 2000 U.S. Census figures for Chicago females was used to estimate population denominators for intercensal years. The 2000 U.S. Census population denominators were used to calculate rates for 2001–2003. All measures were calculated separately for non-Hispanic blacks (hereafter referred to as blacks) and non-Hispanic whites (whites). In order to be consistent with rates published by the National Cancer Institute [22] and the Illinois Department of Public Health [23], five-year average annual rates were used in our analysis to discuss recent incidence (1998–2002) and mortality rates (1999–2003) for female breast cancer. Black:white rate ratios (calculated as the black rate divided by the white rate) were used to measure racial disparities.

We examined the temporal trend in age-adjusted incidence (1986–2002) and mortality rates (1980–2003) using a joinpoint regression model [24]. Each joinpoint denotes a statistically significant change in trend (straight line on a log scale). The overall significance

was set at $p = 0.05$ with a maximum of three joinpoints allowed. The annual percent change (APC) was used to describe the trend for each segment. We also examined the temporal trend in female breast cancer incidence rates by stage of the disease at time of diagnosis (localized, regional, distant).

The stage of disease code was also used to examine trends in the early detection of breast cancer. Specifically, early detection was defined as the incidence of in situ and localized tumors diagnosed per 100,000 women. The decision to combine the in situ and localized tumors as indicative of early detection was based on previously reported studies [25–27]. Tumor size, the other commonly used marker of cancer-development, was not available since the ISCR did not include it before 1995 and the data collected on tumor size since then has been of questionable quality. For example, in 2002, tumor size was only known in 51% of the cases. Thus, for the purposes of this study, early detection was defined to include in situ as well as localized tumors, whereas late detection was defined to include tumors of regional spread and distant metastasis. Where proportions of early stage cancers are presented, they were calculated by excluding those with unknown or missing stage (about 5% of reported cancers).

The incidence of in situ cancers was also examined as an indicator of tumor detection by mammography screening [28, 29]. This is consistent with a recent study that proposed the utility of using in situ cancers to compare mammography rates in different geographic areas [30]. Joinpoint regression and the APC were used to describe changes in trends in the incidence of in situ cancers and the incidence of breast cancers detected early.

For all measures, 95% confidence intervals were calculated and tests of significance carried out at $p = 0.05$ [31, 32].

Results

Mortality

Between 1999 and 2003 the death rate from breast cancer was 49% higher in black women in Chicago than white women (RR = 1.49; 95% CI: 1.36, 1.63) (Table 1). By 2003 the disparity had risen to 68%. The same dynamic existed in the United States (RR = 1.37) [9, 33], but the disparity is much greater in Chicago. As Table 1 indicates, a higher proportion of black women die from breast cancer at a younger age. Specifically, 19.5% of breast cancer deaths in black women were in women less than 50 years of age compared to 9.1% for white women. However, for both women less than 50 years and women 50 years and older, black women have higher mortality rates.

The black:white disparity in breast cancer mortality seen in Chicago in recent years stands in contrast to the more equitable mortality rates between black and white women seen prior to the 1990's (Fig. 1). Since the 1990's, however, there has been an increasing divergence in the rates. In particular, mortality rates in white women remained constant between 1980 and 1994 (APC = 0.4, $p > 0.05$), then dramatically decreased 5.7% per year since 1994 ($p < 0.05$) (Table 2). Black women in Chicago, in contrast, saw their rates increase 3.4% per year from 1980 to 1986 (but not significantly so) and then stabilize since 1986 (APC = –0.3, 95% CI: –1.0, 0.3). Notably, the breast cancer

Table 1 Female breast cancer mortality (1999–2003) and incidence by age (1998–2002), Chicago

	Less than 50 years			50 years and older			Total		
	%[a]	Rate[b]	95% CI[c]	%[a]	Rate[b]	95% CI[c]	%[a]	Rate[b]	95% CI[c]
Mortality									
White	9.1	5.0	3.9, 6.1	90.9	84.9	80.6, 89.1	100.0	27.1	25.2, 29.9
Black	19.5	10.7	9.3, 12.2	80.5	117.8	112.8, 122.9	100.0	40.3	37.9, 42.7
RR[d]		2.15	1.72, 2.70		1.39	1.26, 5.91		1.49	1.36, 1.63
Incidence									
White	18.6	49.4	46.0, 52.9	81.4	408.1	397.2, 418.9	100.0	148.5	144.0, 153.1
Black	25.4	44.4	41.4, 47.3	74.6	340.9	331.4, 350.4	100.0	126.3	122.1, 130.6
RR[d]		0.90	0.82, 0.99		0.84	0.79, 0.87		0.85	0.81, 0.89

[a] Proportion of deaths/cases

[b] Age-adjusted mortality or incidence rate per 100,000 women

[c] The 95% confidence interval for the age-adjusted rate or the black:white rate ratio

[d] Black:white rate ratio

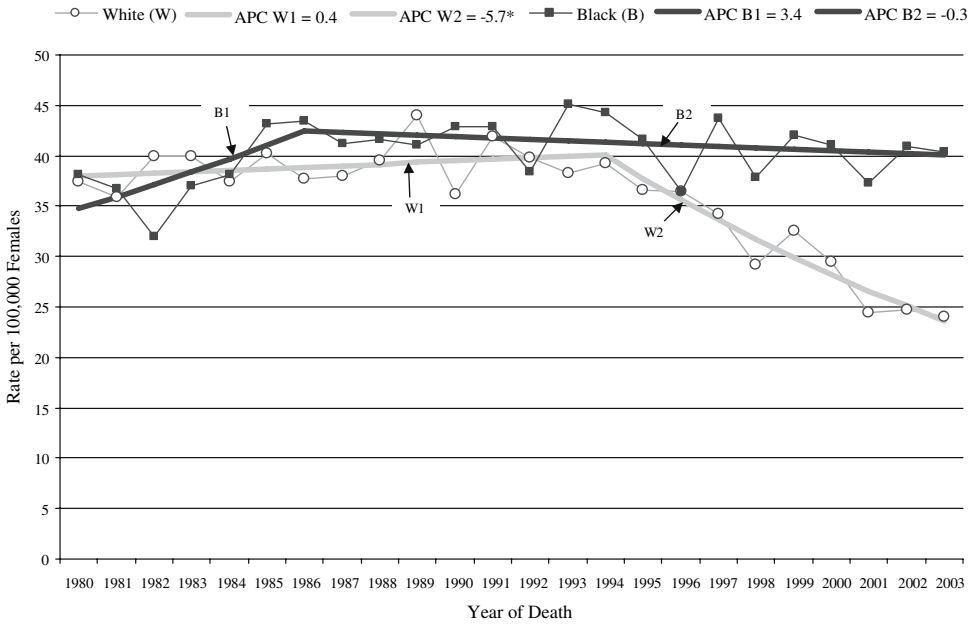

Fig. 1 Female breast cancer mortality rates,[a] Chicago, 1980–2003

* The APC, Annual Percent Change, is statistically different from zero ($p < 0.05$)
[a] Rates are age-adjusted to the 2000 US Standard Population

mortality rate for black women increased slightly between 1980 (38.1) and 2003 (40.4) while the white rate fell by 36%, from 37.4 to 24.0. In 1999 the black:white RR was 1.29 (95% CI: 1.07, 1.56). By 2003 it had increased to 1.68 (95% CI: 1.37, 2.07) after increasing every year in this interval.

Incidence

In contrast to their higher death rates, black women in Chicago have a lower incidence of breast cancer compared to white women (RR = 0.85; 95% CI: 0.81, 0.89) (Table 1). When considering incidence rates by age, a higher proportion of black women (25.4%) are diagnosed with breast cancer at a young age compared to white women in Chicago (18.6%). Despite the higher proportion of breast cancers diagnosed in younger black women, the actual incidence of breast cancer in women less than 50 years old is still slightly lower for black women (RR = 0.90; 95% CI: 0.82, 0.99).

Since 1986, breast cancer incidence rates for white women in Chicago have varied slightly but resulted in an APC = –0.0 overall. In contrast, incidence rates for black women in Chicago have been steadily increasing by 1.2% per year ($p < 0.05$) (Fig. 2) with much of this due to an increase in localized-staged disease (1.8%, $p < 0.05$) (Table 2). Rates for localized-staged disease also increased for white women in the same time period, a modest but significant 0.7%. In contrast, the rates of regional-staged disease decreased for white women by –0.9% ($p < 0.05$), while levels of

Table 2 Trends in breast cancer mortality (1980–2003) and incidence by stage at diagnosis (1986–2002), Chicago

* The APC, Annual Percent Change, is statistically different from zero ($p < 0.05$)
[a] APC is based on rates age-adjusted to the 2000 US standard population and is determined by joinpoint regression program, with a maximum of three joinpoints (i.e., four line segments)
[b] The 95% confidence interval for the APC

Race/stage	Line segment 1			Line segment 2		
	Years	APC[a]	95% CI[b]	Years	APC[a]	95% CI[b]
Mortality						
White	1980–1994	0.4	–0.4, 1.1	1994–2002	–5.7*	–7.3, –4.0
Black	1980–1986	3.4	–0.2, 7.1	1986–2002	–0.3	–1.0, 0.3
Incidence						
White						
All stages	1986–2002	–0.0	–0.4, 0.3			
Localized	1986–2002	0.7*	0.1, 1.3			
Regional	1986–2002	–0.9*	–1.4, –0.4			
Distant	1986–2002	–2.8*	–3.6, –2.0			
Black						
All stages	1986–2002	1.2*	0.6, 1.7			
Localized	1986–2002	1.8*	1.2, 2.4			
Regional	1986–2002	0.6	–0.3, 1.4			
Distant	1986–1992	–5.9*	–10.2, –1.4	1992–2002	–1.1	–3.3, 1.2

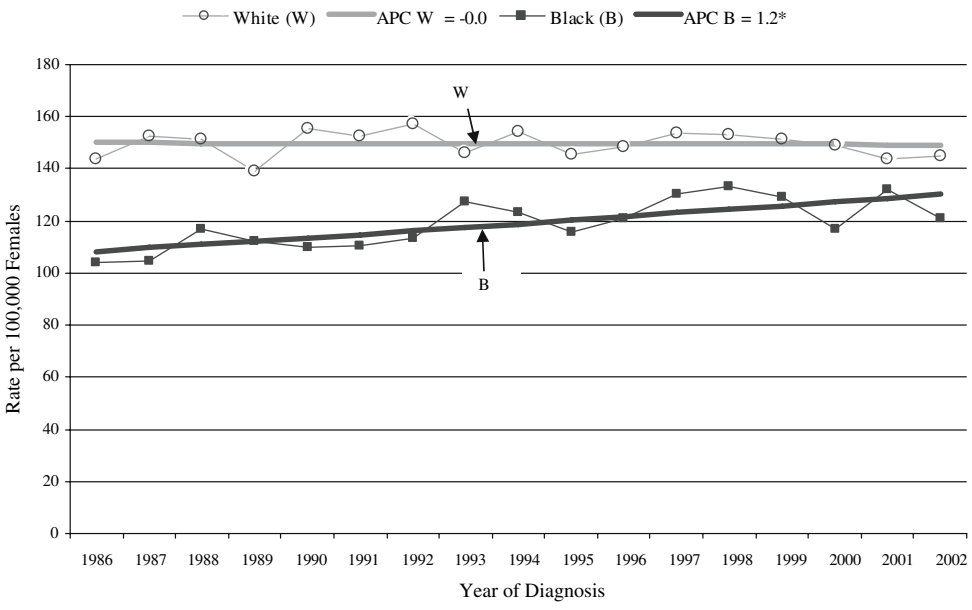

Fig. 2 Female breast cancer incidence rates,[a] Chicago, 1986–2002

* The APC, Annual Percent Change, is statistically different from zero ($p < 0.05$)
[a] Rates are age-adjusted to the 2000 US Standard Population

regional-staged disease remained constant for black women. Rates of distant-staged disease decreased for both white and black women from 1986 to 1992, but the rates stabilized for black women after 1992 while continuing to decline for white women.

Early detection

Since 1986, the incidence of early stage breast cancer has increased appreciably for both black and white women. For black women the increase was 3.3% per year ($p < 0.05$), while for white women it was 1.9% ($p < 0.05$) (Fig. 3). However, there still exists a substantial black:white disparity in the early detection of breast cancers (1998–2002; RR = 0.69; 95% CI: 0.66, 0.73; data not shown). Consequently, black women in Chicago are more likely than white women to be diagnosed with late stage disease.

Use of mammography

In Chicago, the proportion of black women age 40 and older that report having a mammogram in the last two years has been similar to (or higher than) that of white women since 1996, the first year that such data have been available (Fig. 4). Since 1986, there has also been an increase in the incidence of in situ breast cancers for both white and black women (Fig. 5). Overall, rates of

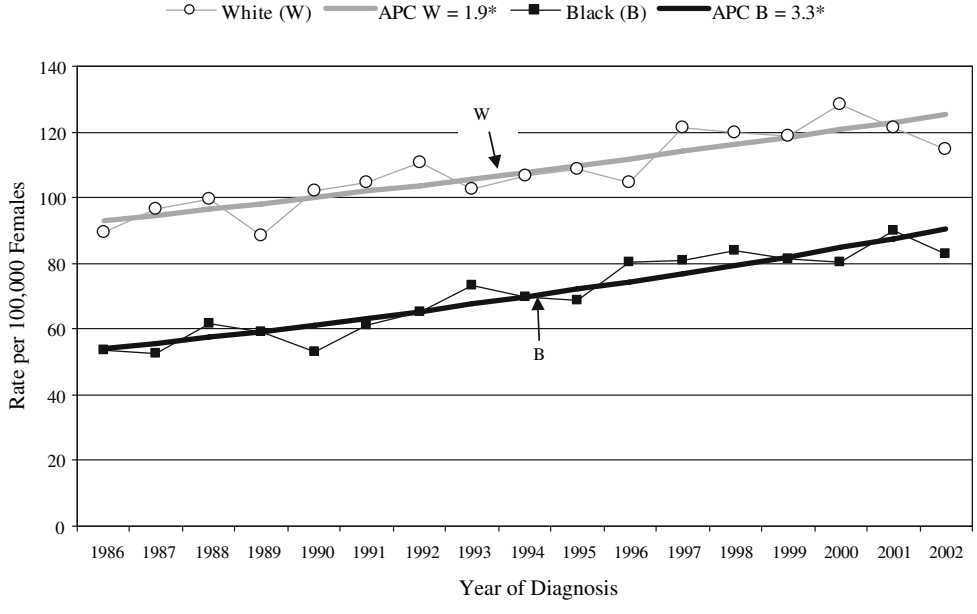

Fig. 3 Female breast cancer incidence rates at an early stage at diagnosis,[a, b] Chicago, 1986–2002

* The APC, Annual Percent Change, is statistically different from zero ($p < 0.05$)
[a] Rates are age-adjusted to the 2000 US Standard Population
[b] Early stage at diagnosis is defined as either in situ or localized-staged disease

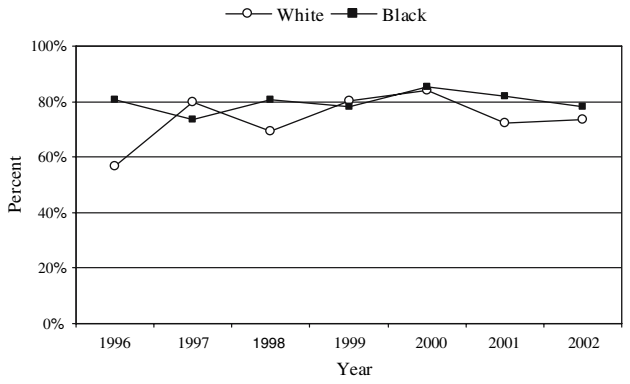

Fig. 4 Proportion of women 40 years of age and older who report having had a mammogram in the past two years, Chicago, 1996–2002

in situ cancers have been increasing 6.7% per year in white women ($p < 0.05$) and 9.7% in black women ($p < 0.05$). However, as substantial as the increase in the incidence of in situ cancers is for black women in Chicago, the black rate still lags behind the white rate (1998–2002; RR = 0.67; 95% CI: 0.64, 0.70; data not shown).

Discussion

Findings

The motivation for this study was to document black:white disparities in breast cancer mortality in Chicago and to explore why they exist. To that end, we have created a profile of female breast cancer that brings incidence and mortality data together with other important measures associated with breast cancer such as screening and stage of diagnosis. It represents the first published epidemiologic profile of breast cancer for the city of Chicago, and likely the first for any local area (e.g., county, metropolitan area, or city).

Our profile has allowed us to make several important observations about the black:white disparity in breast cancer mortality in Chicago. To begin, we found that, as in the rest of the U.S., breast cancer mortality is higher for black women than for white women in Chicago, confirming and updating the findings of Margellos et al. [10]. In addition, this study adds the observation that the disparity in breast cancer mortality in Chicago is a relatively recent phenomenon. We found that the black and white mortality rates only started to diverge in the 1990's, and that this divergence was the result of a sharp improvement in mortality among white women contrasted with no improvement for black women (Fig. 1). By 2003 the black:white RR was 1.68. Notably, although data are not available for Chicago before 1980, national breast cancer mortality date demonstrate an analogous long-term trend. In fact, white mortality rates exceeded black rates before 1980 [34].

In other words, in 23 years, despite substantial national and local efforts to reduce breast cancer mortality among black women by promotion of mammography [35] and advances in therapy [36], we have not been able to improve mortality from breast cancer for black women in Chicago even though we

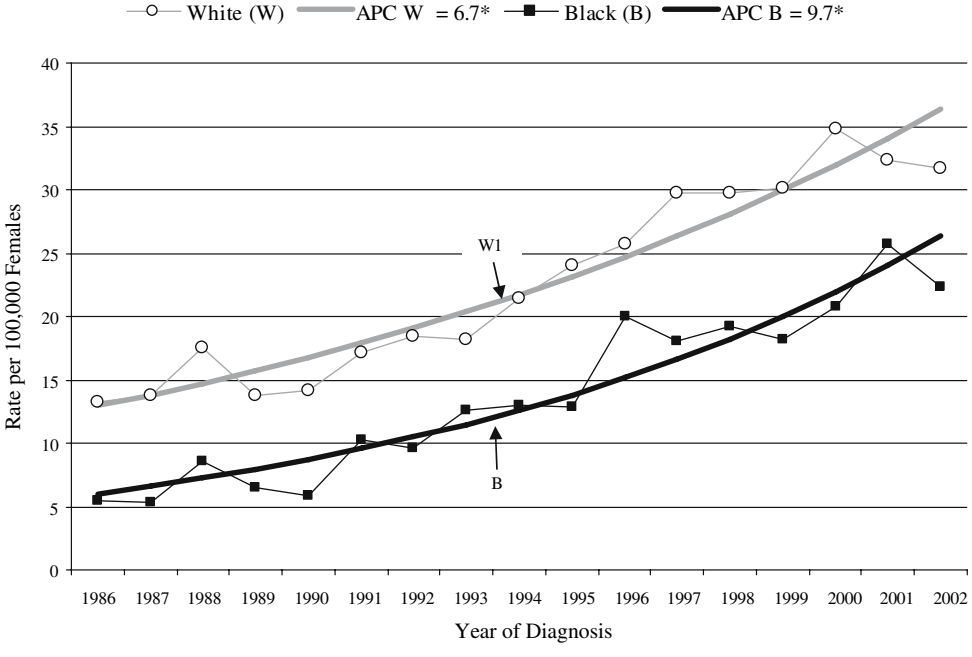

Fig. 5 Female in situ breast cancer incidence rates,[a] Chicago, 1986–2002

* The APC, Annual Percent Change, is statistically different from zero ($p < 0.05$)
[a] Rates are age-adjusted to the 2000 US Standard Population

have been able to improve it dramatically for white women. This is markedly different from other disparities in health where, while gaps persist (for example in cardiovascular disease mortality), reductions in mortality have been seen for both races [37, 38].

The failure to find a reduction in breast cancer mortality among black women in Chicago is more perplexing given three other observations from our profile. First, self-reported mammography screening rates have been the same for blacks and whites in Chicago since at least 1996 (Fig. 4). Second, black early breast cancer incidence rates have been increasing over time (Fig. 3) as has the incidence of in situ cancer (Fig. 5) while the incidence of distant breast cancers among black women has decreased (Table 2). Why has breast cancer mortality not been reduced by the growth of this early detection? Third, while the in situ and early breast cancer incidence rates have risen among black women they have lagged behind that of whites despite equivalent self-reported mammography rates. If screening rates are the same, should not early detection rates be equivalent as well?

While our data do not directly provide the answers to these questions there are only a limited number of possible explanations. Some of these explanations are related to mammography. We discuss these first.

The first mammography-related explanation is that self-reported mammography rates may not be accurate. Chicago BRFSS data show no differences in the proportions of black and white women over 40 who have received mammograms in the past two years (Fig. 4). Similar findings have been reported for virtually all local and national surveys [39, 40]. However, the data presented in this paper indicate that large disparities in early breast cancer detection rates and in situ detection rates persist. This observation is inconsistent with equivalent screening rates. In this context it is important to note that substantial literature suggests that self-reported mammography rates (both on the phone and in person) may be problematic [41–47] since poor and black women tend to over-report mammography. One report suggested that such over-reporting could be as high as 25–30% [48].

A second possible mammography-related explanation for the conflicting information explicated in this analysis is that the mammography rates measured by receipt of a mammogram in the past two years may be correct, but black women may be less likely to receive an optimal mammography sequence such as two mammograms in three years or three in five years. If black women are less likely than whites to receive adequately sequential mammograms, then disparities in mortality might exist even in the face of equal screening rates within the past two years. Unfortunately, sequential mammography screening data are rarely collected [49] thus making this hypothesis difficult to examine.

Nevertheless, the relationship between adequate utilization of screening mammography (measured by medical record rather than by self-report) and early and small tumor detection has recently been confirmed in a study examining breast cancer outcomes from more than one million women. Smith-Bindman and her colleagues found that black women were less likely than white women to have received adequate mammogram screening. When recency of mammography was controlled for, the disparities in early and small tumors were generally eliminated [50].

A third possible mammography-related explanation, which is rarely discussed in the literature as a risk factor for racial disparities concerns differential quality in mammography screening. For example, it may be that black women are getting mammograms as often as white women, but that the mammograms are of poorer quality. This poor quality could manifest itself in the administration of the mammogram (e.g., positioning), quality of the film, quality of the machine, quality of the radiologist, quality of the follow-up for abnormal screens, etc. The American College of Radiology (ACR), sanctioned by the Mammography Quality Standards Act and the Food and Drug Administration, sets specific standards for accreditation. However, many other ACR mammography benchmarks are recommendations for voluntary compliance but are not requirements [51]. It is reasonable to hypothesize that there may be variation in mammography quality. Examination of these benchmarks may therefore prove useful.

Some evidence suggests that such inferior quality may indeed exist in some locations. For many screening mammography series, based upon millions of women combined, the breast cancer detection rate has been in the range 0.005–0.007 [50, 52–54]. Such values depend, of course, on many factors such as previous screening experiences, age, etc. However, these rates may be seen as good averages that one might expect for general series of population screens.

At one Chicago organization that serves low-income women, and where one of us worked, 15,501 mammograms were provided and only 37 breast cancers were detected for a rate of 0.0024. In other words, poor screening quality may have led to many undiagnosed cases at this site. In another example, the New York State Health Department audited a clinic that performs mammography in New York City after it came under suspicion for missing breast cancers. It was

found that the breast cancer detection rate there was 0.001. After recalling 4,500 women who had already been screened at that clinic an additional 25 breast cancers were found [55, 56]. Taken together these observations suggest that a disparity in mammography quality may be a plausible hypothesis in explaining at least some of the black:white disparity in breast cancer mortality. Yet, this issue has been explored in only one study [57] despite the fact that black:white disparities in health care quality have been demonstrated in dozens of areas [58–61].

There are, of course, other explanatory hypotheses for the black:white disparity in breast cancer mortality that are not related to mammography. One that is widely cited in the literature maintains that black:white biological differences in breast cancers are responsible for the differentials in the black:white incidence of early breast cancer and mortality, suggesting that breast cancer in black women is biologically more aggressive than that in whites [62, 63]. However, biological differences could not explain the difference in stage at diagnosis unless one presumes that mammography screening is inefficacious in black women. Also, mortality rates only began to diverge for black and white women in Chicago in the past eight years, and similarly recently in Ohio [13] and the entire US [64]. This suggests that something other than biology, such as screening and treatment, might be the operant variable [36]. Finally, in randomized controlled trials of breast cancer treatment, black women have had similar survival rates as white women [65]. Such information suggests that biological differences may be overemphasized as causal factors for black breast cancer mortality.

Another explanation that is offered concerns the differences in racial dynamics in breast cancer for those women under 50 and those 50 or older [49, 63]. However, it is obvious from Table 1 that whatever one makes of this phenomenon, it could only impact on the larger question of black:white mortality disparities in a minor way since women under 50 constitute only a small part of the picture (20% of the black deaths and 9% of the white deaths) and substantial mortality disparities remain even after controlling for this age effect.

Finally, differential access to treatment and quality of care almost certainly explain part of the black:white differences in breast cancer mortality [8, 36, 66–68]. There is a body of literature that suggests that the quality of care for black and poor women diagnosed with breast cancer is different than that for whites. For example, black and poor women are more likely to experience delays in diagnosis and treatment and less likely to receive evidence-based treatment [8, 36, 66–68].

Methodological considerations

Our study has some limitations. First, vital records data and cancer registry data are regarded as some of the most complete and accurate of the public health data sources; however, neither adequately collects information on variables that may be of importance in breast cancer epidemiology, such as the women's socioeconomic status (SES) and co-morbid conditions. ISCR also does not have information on tumor size, tumor histology, hormone receptors, treatments received, or subsequent survival. Without such data it is not possible to know the extent to which the black:white disparities found in our study are explained by these factors. It would be important in future studies to examine the potential mediating impact of SES as well as the effects of some of these biological variables.

Of particular concern is the lack of data on tumor size when examining the rate of early detection. In this study, we included both in situ and localized tumors as indicative of early detection, however, localized tumors are not necessarily new cancers, but can include substantially sized tumors (>1 cm) that have not yet metastized. Including them in counts of early cancers may have over estimated the incidence of early cancer.

Conclusions

This profile, based upon the simultaneous analysis of four separate data bases, has allowed us to gain new insights into the nature of the racial disparity in breast cancer mortality, its recent dramatic growth, and to understand three possible paths to remedying the situation. Chicago, struggling to meet the Healthy People 2010 and National Cancer Institute 2015 Challenge Goals of eliminating disparities in breast cancer mortality, is an obvious setting for an attempt to improve racial inequities in breast cancer mortality. It is our hope that this profile will help stimulate the health care community in the city (and elsewhere as well) to investigate why the mortality rate for black women is not improving—especially at a time when the white mortality rate is decreasing so significantly. The analyses presented here represent only the first step. Thus, we offer some specific suggestions for pursuing racial equality in breast cancer mortality:

(1) A definitive answer must be developed as to whether self-reported mammography experience

is valid for different race and ethnic groups. Such an answer may be provided by meta-analyses or substantive detailed studies that examine this question. The recent paper by Kagay et al. is one example [47]. If self-reported mammography is found to be invalid then it should be discarded as a measure of this experience, despite the fact that it is easy to measure.

(2) All studies that gather information about mammography use should measure not only receipt in the past two years but some form of sequence. We suggest gathering data about the number of mammograms in the past three years or even the past five years.

(3) Measures of mammography quality [51, 69, 70] should be examined and utilized by all mammography centers. These measures should be consistent with recommendations set forward in the Institute of Medicine's recent study [51] and benchmarks provided by the American College of Radiology [69]. The calculation and display of such metrics are part of a much larger quality improvement pursuit that often goes under the title of ''transparency'' [71] and is consistent with Recommendation 2 of the IOM report [51].

(4) Many papers discuss racial differences in breast cancer biology [62, 72]. This area of study concerns us given the historic misuse of biological differences and given that there is substantial literature which refutes the notion of the existence of ''races'' as biological groups as opposed to socially constructed ones [73–75]. We do not suggest here that biological factors in racial disparities in breast cancer mortality (or any other topic) cannot be discussed. We do mean, however, that such areas of investigation carry with them a greater burden of clarity and proof. Biological differences in the races as cause of disparities in breast cancer mortality is one area that requires great care.

We hope this analysis helps give direction to the future development and funding of research and interventions to address the issues examined in this paper. This profile lends support to the possibility that the disparities in breast cancer mortality may be due to differential access to mammography, differential quality in mammography, and differential access to treatment for breast cancer, which is consistent with the findings from a recent prominent report [36]. Fortunately, these factors are amenable to intervention and remedying them offers the potential to appreciably reduce disparities in breast cancer mortality [76].

As noted by Brawley and Freeman, ''Deep ethical and moral questions [are raised] concerning how the research community, the American health care system, and society as a whole will move toward providing remedies for this unacceptable reality [disparities in health]'' [77]. As Brawley wrote a few years later in an editorial about disparities in breast cancer outcomes, ''The disparity remains an unacceptable reality, and it is an unsettling truth that we, as a society, have made meager efforts to even recognizing the problem. The solutions are not simple, but we must try'' [64].

Acknowledgments Many thanks to our colleague Jade Dell for her assistance in preparing this manuscript. Work on this paper was supported by funding from Illinois Department of Public Health, Stand Against Cancer Initiative, Grant #60180053.

References

1. American Cancer Society (2004) Breast cancer facts and figures, 2004. American Cancer Society, Inc., Atlanta, GA
2. Jemal A, Thomas A, Murray T, Thun M (2002) Cancer statistics. 2002. CA Cancer J Clin 52:23–47
3. U. S. Department of Health and Human Services (1991) Healthy people 2000: national health promotion and disease prevention objectives. U.S. Government Printing Office, Washington, DC
4. U.S. Department of Health and Human Services (2000) Healthy people 2010: understanding and improving health and objectives for improving health. U.S. Government Printing Office, Washington, DC
5. Bigby J, Holmes MD (2005) Disparities across the breast cancer continuum. Cancer Causes Control 16:35–44
6. Elmore JG, Nakano CY, Linden HM, Reisch LM, Ayanian JZ, Larson EB (2005) Racial inequities in the timing of breast cancer detection, diagnosis, and initiation of treatment. Med Care 43:141–148
7. Roetzheim RG, Gonzalez EC, Ferrante JM, Pal N, Van Durme DJ, Krischer JP (2000) Effects of health insurance and race on breast carcinoma treatments and outcomes. Cancer 89:2202–2213
8. Joslyn SA (2002) Racial differences in treatment and survival from early-stage breast carcinoma. Cancer 95:1759–1766
9. Hoyert DL, Heron MP, Murphy SL, Kung H (2006) Deaths: final data for 2003. National vital statistics reports: vol 54 no 13. National Center for Health Statistics, Hyattsville, MD
10. Margellos H, Silva A, Whitman S (2004) Comparison of health status indicators in Chicago: are black-white disparities worsening? Am J Public Health 94:116–121
11. Centers for Disease Control and Prevention: Office of Minority Health (Online) Eliminating racial & ethnic health disparities. Available from URL: http://www.cdc.gov/omh/AboutUs/disparities.htm [accessed 11 July 2006]
12. National Cancer Institute (Online) NCI challenge goal 2015: eliminating the suffering and death due to cancer. Available from URL: http://www.cancer.gov/aboutnci/2015 [accessed 11 July 2006]
13. Tyczynski JE, Hill TD, Berkel HJ (2006) Why do postmenopausal African-American women not benefit from overall breast cancer mortality decline? Ann Epidemiol 16:180–190

14. U.S. Census Bureau (Online) Census 2000, summary file 1. Generated by J Hirschman, using American FactFinder. Available from URL: http://factfinder.census.gov [accessed 11 July 2006]
15. Illinois Department of Public Health, Illinois State Cancer Registry (2004) Cancer incidence data 1986–2002; data as of November 2004
16. Percy C, Van Holten V, Muir C (1990) International classification of diseases for oncology, 2nd edn. World Health Organization, Geneva, Switzerland
17. Fritz A, Percy C, Jack A et al (2000) International classification of diseases for oncology, 3rd edn. World Health Organization, Geneva, Switzerland
18. Young JL Jr, Roffers SD, Ries LAG, Fritz AG, Hurlbert A (eds) (2001) SEER summary staging manual – 2001: codes and coding instructions. National Cancer Institute, Bethesda, MD. NIH Pub. No. 01-4969
19. ICD-9-CM Codebook 2001, 6th edn (2000) Vols 1, 2 & 3. St. Anthony's Publishing, Reston, VA
20. World Health Organization (2006) International statistical classification of diseases and related health problems, 10th revision, Version for 2006. Available from URL: http://www3.who.int/icd/currentversion/fr-icd.htm [accessed 11 July 2006]
21. Nelson DE, Holtzman D, Waller M, Leutzinger C, Condon K (1998) Objectives and design of the Behavioral Risk Factor Surveillance System. Paper presented at American Statistical Association National Meeting, Dallas TX
22. Ries LAG, Eisner MP, Kosary CL et al (eds) SEER cancer statistics review, 1975–2002. National Cancer Institute, Bethesda, MD. Available from URL: http://seer.cancer.gov/csr/1975_2002/. Based on November 2004 SEER data submission, posted to the SEER web site 2005 [accessed 11 July 2006]
23. Illinois Department of Public Health (Online) Cancer in Illinois: statistics. Available from URL: http://www.idph.state.il.us/cancer/statistics.htm. [accessed 11 July 2006]
24. Kim HJ, Fay MP, Feuer EJ, Midthune DN (2000) Permutation tests for joinpoint regression with applications to cancer rates. Stat Med 19:335–351 (correction: 2001; 20:655)
25. Richardson LC, Schulman J, Sever LE, Lee NC, Coate RJ (2001) Early-stage breast cancer treatment among medically underserved women diagnosed in a national screening program. Breast Cancer Res Treat 69:133–142
26. Nasseri K (2004) Secular trends in the incidence of female breast cancer in the United States, 1973–1998. Breast J 10(2):129–135
27. Harris DH, Bates JH, Cress R, Tabnak F, Wright WE (2004) Stage of breast cancer diagnosis among medically underserved women in California receiving mammography through a state screening program. Cancer Causes Control 15:721–729
28. Ernster VL, Barclay B, Kerlikowske K, Grady D, Henderson C (1996) Incidence of and treatment for ductal carcinoma in situ of the breast. JAMA 275:913–918
29. Ernster VL, Ballard-Barbash R, Barlow WE et al (2002) Detection of ductal carcinoma in situ in women undergoing screening mammography. J Natl Cancer Inst 94:1546–1554
30. McElroy JA, Remington PL, Gangnon RE, Hariharan L, Anderson LD (2006) Identifying geographic disparities in early detection of breast cancer using a geographic information system. Prev Chronic Dis [serial online] 3(1):1–8. Available from URL: http://www.cdc.gov/pcd/issues/2006/jan/05_0065.htm [accessed 14 June 2006]
31. Chiang CL (1961) Standard error of the age-adjusted death rate. Vital Stat Selected Rep 47:275–285
32. Rothman KJ (1986) Modern epidemiology. Little, Brown and Company, Boston, MA
33. Keppel KG, Pearcy JN, Wagener DK (2002) Trends in racial and ethnic-specific rates for the Health Status Indicators: United States, 1990–98. In: Healthy people statistical notes. No. 23. National Center for Health Statistics, Hyattsville, MD
34. Chu KC, Tarone RE, Brawley OW (1999) Breast cancer trends of black women compared with white women. Arch Fam Med 8:521–528
35. Breen N, Wagener DK, Brown ML, Davis WW, Ballard-Barbash R (2001) Progress in cancer screening over a decade: results of cancer screening from the 1987, 1992, and 1998 National Health Interview Surveys. J Natl Cancer Inst 93:1704–1713
36. Berry DA, Cronin KA, Plevritis SK et al (2005) Effect of screening and adjuvant therapy on mortality from breast cancer. N Engl J Med 353:1784–1792
37. Cooper R, Cutler J, Desvigne-Nickens P et al (2000) Trends and disparities in coronary heart disease, stroke, and other cardiovascular diseases in the United States: findings of the national conference on cardiovascular disease prevention. Circulation 102:3137–3147
38. Pearcy JN, Keppel KG (2002) A summary measure of health disparity. Public Health Rep 117:273–280
39. Coughlin SS, Uhler RJ, Bobo JK, Caplan L (2004) Breast cancer screening practices among women in the United States, 2000. Cancer Causes Control 15:159–170
40. Centers for Disease Control and Prevention (2005) Breast cancer screening and socioeconomic status – 35 metropolitan areas, 2000 and 2002. MMWR 54:981–985
41. Norman SA, Localio AR, Zhou L et al (2003) Validation of self-reported screening mammography histories among women with and without breast cancer. Am J Epidemiol 158(3):264–271
42. Carney PA, Goodrich ME, Mackenzie T et al (2005) Utilization of screening mammography in New Hampshire. Cancer 104(8):1726–1732
43. Armstrong K, Long JA, Shea JA (2004) Measuring adherence to mammography screening recommendations among low-income women. Prev Med 38(6):754–760
44. Caplan LS, Mandelson MT, Anderson LA (2003) Validity of self-reported mammography: examining recall and covariates among older women in a health maintenance organization. Am J Epidemiol 157:267–272
45. Caplan LS, McQueen DV, Qualters JR, Leff M, Garrett C, Calonge N (2003) Validity of women's self-report of cancer screening test utilization in a managed care population. Cancer Epi Bio Prev 12:1182–1187
46. Fiscella K, Franks P, Meldrum S (2004) Estimating racial/ethnic disparity in mammography rates: it all depends on how you ask the question. Prev Med 39:399–403
47. Kagay CR, Quale C, Smith-Bindman R (2006) Screening mammography in the American elderly. Am J Prev Med 31(2):142–149
48. Peek ME, Han JH (2004) Disparities in screening mammography: current status, interventions, and implications. J Gen Intern Med 19:184–194
49. Jones BA, Patterson EA, Calvocoressi (2003) Mammogram screening in African American women: evaluating the research. Cancer 97(1 Suppl):258–272
50. Smith-Bindman R, Miglioretti DL, Lurie N et al (2006) Does utilization of screening mammography explain racial and ethnic differences in breast cancer? Ann Intern Med 144:541–553

51. Nass S, Ball J (eds) (2005) Improving breast imaging quality standards. The National Academies Press, Washington, DC
52. May DS, Lee NC, Richardson LC, Giustozzi AG, Bobo JK (2000) Mammography and breast cancer detection by race and Hispanic ethnicity: results from a national program (United States). Cancer Causes Control 11:697–705
53. Wang H, Karesen R, Hervik A, Thoresen SO (2001) Mammography screening in Norway: results from the first screening round in four countries and cost-effectiveness of a modeled nationwide screening. Cancer Causes Control 12:39–45
54. NHS Breast Screening Programme (2003) Serving women for 15 years. Patnick J (ed). NHSBSP, Sheffield, England. Available from URL: www.cancerscreening.nhs.uk [accessed 17 July 2006]
55. Moss M, Steinhauer J (2002) ''Mammogram clinic's flaws highlight gaps in U.S. rules.'' The New York Times 24:A1
56. Centers for Disease Control and Prevention (2004) Breast cancer – screening data for assessing quality of services – New York, 2000–2003. MMWR 53(21):455–457
57. Jones BA, Culler CS, Kasi SV, Calvocoressi L (2001) Is variation in quality of mammographic services race linked? J Health Care Poor Underserved 12:113–126
58. Smedley BA, Stith AY, Nelson AR (eds) (2003) Unequal treatment: confronting racial and ethnic disparities in health care. National Academies Press, Washington, DC
59. Williams DR (1999) Race, socioeconomic status, and health: the added effects of racism and discrimination. Ann NY Acad Sci 896:173–188
60. Satcher D (2006) Challenging the status quo. J Health Care Poor Underserved 17(1):xii–xiv
61. Bloche MG (2004) Health care disparities: science, politics, and race. N Engl J Med 350:1574–1576
62. Cunningham JE, Butler WM (2004) Racial disparities in female breast cancer in South Carolina: clinical evidence for a biological basis. Breast Cancer Res Treat 88:161–176
63. Vastag B (2003) Breast cancer racial gap examined. JAMA 290:1838–1839
64. Brawley OW (2002) Disaggregating the effects of race and poverty on breast cancer outcomes. J Nat Cancer Inst 94:471–473
65. Digman J, Redmont C, Fisher B, Constantino J, Edwards B (1997) Prognosis among African-American women and white women with lymph node negative breast carcinoma: findings from two randomized clinical trials of the National Surgical Adjuvant Breast and Bowel project (NSABP). Cancer 80:80–90
66. Shavers VL, Brown ML (2002) Racial and ethnic disparities in receipt of cancer treatment. J Natl Cancer Inst 94:334–357
67. Griggs JJ, Sorbero ME, Stark AT, Heininger SE, Dick AW (2003) Racial disparity in the dose and dose intensity of breast cancer adjuvant chemotherapy. Breast Cancer Res Treat 81:21–31
68. Jones BA, Dailey A, Calvocoressi L et al (2005) Inadequate follow-up of abnormal screening mammograms: findings from the race differences in screening mammography process study (United States). Cancer Causes Control 16:809–821
69. Yankaskas BC, Klabunde CN, Ancelle-Par R et al (2004) International comparison of performance measures for screening mammography: can it be done? J Med Screening 11:187–193
70. Sickles EA, Wolverton DE, Dee KE (2002) Performance parameters for screening and diagnostic mammography: specials and general radiologists. Radiology 224:861–869
71. Sipkoff M (2004) Transparency called key to uniting cost control, quality improvement. Managed Care 13(1):38–42
72. Li C, Daling J, Malone K (2003) Incidence of invasive breast cancer by hormone receptor status from 1992 to 1998. J Clin Oncol 22:47–53
73. Allen TW (1994) The invention of the white race. Verso Press, New York, NY
74. Cooper RS (2003) Race, genes, and health—new wine in old bottles? Int J Epidemiol 32:23–25
75. Freeman HP (1998) The meaning of race in science – considerations for cancer research. Cancer 82:219–225
76. Blackman DJ, Masi CM (2006) Racial and ethnic disparities in breast cancer mortality: are we doing enough to address the root causes? J Clin Oncol 24:2170–2178
77. Brawley OW, Freeman HP (1999) Race and outcomes: is this the end of the beginning for minority health research? J Natl Cancer Inst 91:1433–1440