

# Survival Difference between Non-Hispanic Black and Non-Hispanic White Women with Localized Breast Cancer: The Impact of Guideline-Concordant Therapy

Xiaocheng Wu; Lisa C. Richardson, MD, MPH; Amy R. Kahn, MS; John P. Fulton, PhD; Rosemary D. Cress, PhD; Tiefu Shen, PhD; Holly J. Wolf, PhD, MSPH; Susan Bolick-Aldrich, MSPH; and Vivien W. Chen, PhD

**Financial support:** The data used for this publication were collected by the Centers for Disease Control and Prevention's (CDC's) National Program of Cancer Registries (NPCR) Patterns of Care Study, which was funded by CDC through cooperative agreements with the participating state cancer registries.

This manuscript is written on behalf of the Patterns of Care Study Group. The findings and conclusions in this report are those of the authors and do not necessarily represent the views of CDC.

**Objectives:** This study examined the impact of guideline-concordant therapy on the survival difference between non-Hispanic black (NHB) and non-Hispanic white (NHW) women with localized breast cancer.

**Methods:** Data analyzed were from the CDC's NPCR Patterns of Care study in which seven population-based state cancer registries participated. We randomly selected 2,362 women who were diagnosed with a first primary localized breast cancer in 1997. Data were abstracted from hospital records, supplemented by information from physician offices and by linkages with state vital records and the National Death Index database.

**Results:** NHB women were more likely than NHW women to receive breast conserving surgery without radiation therapy. In addition, the percentage of NHB women with hormone receptor-positive tumors who received hormonal therapy was lower than that of NHW women. Among those with a tumor size >3 cm, NHB women were more likely than NHW women to receive multiagent chemotherapy. After controlling for age, the risk of dying from all causes of death was 2.35 times as high for NHB women compared to NHW women. Controlling for treatment further reduced black-white difference in survival with adjustment for sociodemographic and clinical variables.

**Conclusion:** NHB women were less likely than NHW women to receive guideline-concordant radiation therapy after breast conserving therapy and hormonal therapy but were more likely to receive chemotherapy. Racial differences in treatment contribute significantly to the worse survival of NHB women compared with NHW women.

**Key words:** breast cancer ■ chemotherapy ■ race/ethnicity ■ survival ■ cancer

© 2008. From Louisiana Tumor Registry, Epidemiology Program, School of Public Health, Louisiana State University Health Sciences Center, New Orleans, LA (Wu, Chen, cancer epidemiologists); Comprehensive Cancer Control Branch, Division of Cancer Prevention and Control, Centers for Disease Control and Prevention, Atlanta, GA (Richardson, medical officer, oncologist); New York State Cancer Registry, New York State Department of Health, Corning Tower, Albany, NY (Kahn, cancer epidemiologist); Rhode Island Cancer Registry, Rhode Island Department of Health, Providence, RI (Fulton, epidemiologist); California Cancer Registry, Public Health Institute, Department of Public Health Sciences, University of California, Davis, Sacramento, CA (Cress, cancer epidemiologist); Illinois State Cancer Registry, Illinois State Department of Public Health, Springfield, IL (Shen, chronic disease epidemiologist); Department of Preventive Medicine and Biostatistics, School of Medicine, University of Colorado at Denver and Health Sciences Center, Aurora, CO (Wolf); and South Carolina Central Cancer Registry, Public Health Statistics and Information Services, South Carolina Department of Health and Environmental Control, Columbia, SC (Bolick-Aldrich, cancer registry director). Send correspondence and reprint requests for *J Natl Med Assoc.* 2008;100:490-498 to: Dr. Xiaocheng Wu, Louisiana Tumor Registry, Epidemiology Program, School of Public Health, Louisiana State University Health Sciences Center, 1615 Poydras St., Suite 1400, New Orleans, LA 70112; phone: (504) 568-5763; fax: (504) 568-5800; e-mail: xwu@lsuhsc.edu

It is well known that black women diagnosed with breast cancer have a worse prognosis than white women, even with the same stage of disease.<sup>1-4</sup> One possible reason is that breast cancers among black women are more likely to have aggressive tumor characteristics such as being estrogen receptor (ER) negative or having high tumor grade.<sup>5,6</sup> However, even after controlling for tumor characteristics, black-white differences in survival remain.<sup>7,8</sup> Although the general assumption is that racial disparities in treatment may contribute partially to the worse survival among black women compared to white women, data to support this hypothesis are scarce.<sup>1,9</sup>

Previous studies have suggested that treatment based on established guidelines is not delivered equally across racial/ethnic populations.<sup>3,10,11</sup> Although several studies have been conducted on breast cancer treatment and survival by race, most of them used data from either a single cancer center or a few local healthcare facilities,<sup>1,12</sup> which may not reflect breast cancer treatment patterns and survival in the community setting. Studies using data from

population-based state cancer registries have been limited because of incomplete information on adjuvant cancer treatment in registry data from routine data collection.<sup>13,14</sup> Although data from the Surveillance, Epidemiology and End Results<sup>15</sup> Program's patterns-of-care studies and the SEER–Medicare-linked dataset provide substantial resources to study this topic, these sources are limited in the age groups of women and in geographic coverage.

The Centers for Disease Control and Prevention's (CDC's) National Program of Cancer Registries (NPCR) Patterns of Care (POC) study provided an opportunity to examine the dissemination of guideline-based therapy in the community and its impact on survival in both SEER and non-SEER areas. The objective of this study was to assess the extent to which guideline-based breast cancer therapy for localized breast cancer has disseminated in the community, whether this dissemination was disproportionate for non-Hispanic white (NHW) and non-Hispanic black (NHB) women and, finally, how use of guideline-based therapy impacted survival.

## METHODS

### Data Source

The present study was conducted during 2001–2003. Seven population-based state cancer registries (California, Colorado, Illinois, Louisiana, New York, Rhode Island and South Carolina) participated in this study.<sup>16</sup> Tumors among women with a first primary localized (lymph node negative) breast cancer (ICD-O site codes C50.0–C50.9, behavior code 3) diagnosed in 1997 were randomly selected from each registry's database. Contralateral breast cancers, lymphomas and carcinoid tumors, and cancers identified solely through death certificates or at autopsy were excluded from the sample selection process. Approval from the relevant institutional review board was obtained at each participating university or health department and at CDC before the collection of data.

Data were reabstracted from hospital medical records, supplemented by information from physician offices and, in some cases, from ambulatory surgery or radiation facilities. Because of the small number of cases for other race and ethnicity groups, this study focused only on NHW and NHB women. Out of 2,362 NHW and NHB women in the original sample, a total of 2,302 women were included in the final data analysis. We excluded 29 bilateral synchronous breast tumor cases and five cases without surgery as well as 26 cases due to incomplete data on treatment and missing date of last contact.

### Treatment-Related Variables

Only data on first course of treatment (i.e., treatment given prior to disease progression) were included in the data analysis. To assess dissemination of the guideline-based therapy in the community at the year of cancer diagnosis (1997), we used guidelines issued by the

National Institute of Health Consensus Development Program in 1990 and National Cancer Institute clinical alerts in 1988.<sup>17,18</sup>

### Primary (Surgery and Radiation) Therapy

We categorized primary therapy into three groups: breast-conserving surgery with radiation, mastectomy and breast-conserving surgery only. Mastectomy or breast-conserving surgery with radiation therapy was guideline-concordant primary therapy at the year of cancer diagnosis. Women who received >1 cancer-directed surgery were grouped according to the most aggressive surgery during the first course of treatment. All women included in this study received breast cancer surgery.

### Hormonal Therapy

In addition to three simple categories (i.e., received, not received, unknown), we also categorized hormonal therapy into seven groups in the survival analysis based on hormone receptor status and receipt of hormonal therapy (Table 1) according to the guideline-based therapy applied at the year of cancer diagnosis. Hormone receptor-positive women were those with either positive ER or positive progesterone receptor (PR) tumors. Hormone receptor-negative women were those whose tumors were both ER- and PR negative. Tumors with borderline ER or PR were grouped with the positive ER or PR group, because women with any evidence of hormone receptors in their tumor cells may benefit from hormonal therapy. Women with ER- or PR-positive tumors receiving hormonal therapy were receiving the guideline-concordant hormonal therapy.<sup>17</sup>

### Multiagent Chemotherapy

In addition to three simple categories (i.e., received, not received, unknown), we also categorized multiagent chemotherapy into seven groups in the survival analysis based on tumor size, hormone receptor status and receipt of multiagent chemotherapy (Table 1) to assess dissemination of the guideline therapy applied at the year of cancer diagnosis. Women who received single-agent chemotherapy were counted as not receiving multiagent chemotherapy. Women were grouped in the unknown category if they were known to receive chemotherapy but unknown if single agent or multiagent, if their receipt of chemotherapy was not known, or if they had unknown tumor size or with tumor size <3 cm but with unknown hormone receptor status. Women with tumor size >3 cm or with size ≤3 cm and hormonal receptor-negative tumor receiving multiagent chemotherapy were receiving guideline-concordant chemotherapy.<sup>17</sup>

### Clinical Variables

Data on tumor size, ER and PR status, and tumor grade were abstracted and coded according to the North

American Association of Central Cancer Registry (NAACCR) *Data Standards and Data Dictionary*.<sup>20</sup>

Comorbidity was captured solely by recording International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) codes found on the face sheets of the women's medical records. The index, developed by Charlson et al.,<sup>21</sup> was used to categorize comorbidity into three groups: 0, 1 and  $\geq 2$ , with a higher score indicating a greater burden of comorbid illness.

## Sociodemographic Variables

Individual-level sociodemographic characteristics included race, age at diagnosis, marital status and health insurance. Age at diagnosis was grouped into four categories: <50, 50–59, 60–69 and  $\geq 70$  years. Information on marital status was collected as married, single, separated, divorced, widowed and unknown categories. The separated, divorced and widowed categories were combined in the analysis due to small numbers of cases. Health insurance at diagnosis or at the beginning of the first course of treatment was classified into five groups: private, public, unspecified insurance, no insurance and unknown. The public insurance category included women with federal- and state-funded insurance such as Medicare or Medicaid, while the private insurance category included women who had only private insurance or had private insurance to supplement their public insurance. Because of the small number of cases, we did not separate Medicare from Medicaid in our data analysis.

## Survival Variables

Follow-up information (i.e. date of last contact, vital status, and cause of death) for study subjects was obtained by reviewing hospital medical records, contacting treating physicians, and linking to state mortality files and to the National Death Index dataset of the National Center for Health Statistics. Subjects who were not found to be deceased by the cutoff date (December 31, 2002) were considered to be alive. Survival time was calculated for each subject from the time of diagnosis to date of death or cutoff date, whichever came first. Because information on the specific cause of death was not available for a high proportion of the women included in this study, we performed survival analysis based on all causes of death.

## Statistical Analysis

The Chi-squared test was used to examine racial differences in receiving primary therapy and adjuvant therapies as well as differences in other study variables. Tests of significance for racial comparisons were at a level of  $P < 0.05$ . The actuarial method was used to calculate five-year survival rates.<sup>22</sup> For all the study variables, the risk of death for women in each category relative to a designated reference category was first estimated using the Cox proportional hazards model without adjusting for other variables. Multi-

variable modeling using Cox proportional hazards regression was used to determine the influence of the study factors on racial differences in the risk of death.<sup>22</sup> The groups of related potential explanatory variables were added, first in turn individually and then in a cumulative manner by group of variables such as age, comorbidity, tumor characteristics, health insurance and marital status, and cancer treatment (i.e., primary and adjuvant therapies).

## RESULTS

### Racial Differences in Treatment, Tumor Characteristics and Sociodemographics

NHB women were slightly more likely than NHW women to undergo mastectomy or breast-conserving surgery without radiation therapy (Table 2). Overall, NHW women were more likely than NHB women to receive hormonal therapy regardless of hormone-receptor status of their breast cancers (47% vs. 28%). Among women with hormone receptor-positive tumors, only 43% of NHB women received hormonal therapy, which was significantly lower than that of NHW women (56%). In contrast, NHB women with a large size tumor (>3 cm) were more likely to receive multiagent chemotherapy than NHW women (Figure 1). Among those with a hormone receptor-negative and size 1–3-cm tumor, NHB women were less likely than NHW women to receive chemotherapy although the difference was not statistically significant.

Compared with NHW women, NHB women were more likely to have large tumors, with negative hormone receptor status and high tumor grade (Table 2). NHB women were younger at diagnosis and were more likely to be single and to have either public health insurance or no insurance; they also had higher comorbidity scores than NHW women.

### Associations of Guideline-Concordant Therapies, Tumor Characteristics and Sociodemographics with Risk of Death

Overall, the risk of death from all causes was 2.1 times as great for NHB women as for NHW women. Women who underwent breast-conserving surgery without radiation therapy had a significantly higher risk of death from all causes than women who received either breast-conserving surgery with radiation therapy or mastectomy (Table 1). Women with a hormone receptor-positive tumor who did not receive hormonal therapy had a 55% higher risk of death than their counterparts who received hormonal therapy. Women with hormone receptor-negative tumors had the highest risk of death regardless of receiving hormonal therapy. The risk of death was lower among women with smaller tumors (<3 cm) who received multiagent chemotherapy than their counterparts who had the same hormone receptor status and tumor size but who did not receive multiagent chemotherapy. Women with receptor-positive tumors (size

≤3 cm) had a lower risk of death than their counterparts with receptor-negative tumors regardless of receiving multiagent chemotherapy. Women with larger tumors (>3 cm) who did not receive multiagent chemotherapy had the highest risk of death.

Tumor size, hormone receptor status, tumor grade and comorbidity were all strong predictors of risk of death. Women aged ≥70 years had a higher risk of death than women <70. Married women had a lower risk of death than women who were divorced, separated or widowed ("other" in the table). Women with public health insurance had a higher risk of death than women with private health insurance.

## Results of Multivariable Modeling Comparing Non-Hispanic Black Women with Non-Hispanic White Women on All-Cause Mortality

The results of the proportional hazards models comparing the hazard of death for NHB women with NHW women are summarized in Table 3. With adjustment for age at diagnosis, the risk of death from all causes for NHB women was more than double that for NHW women. Comorbidity, tumor characteristics, cancer treatment and health insurance each contributed substantially to the racial difference in risk of death after adjust-

**Table 1. Unadjusted hazard ratios indicating the effect of selected factors on overall survival\* among women diagnosed with localized breast cancer in 1997 (Centers of Disease Control and Prevention Patterns of Care study)**

Characteristic	Number	5-Year Survival (%)	Hazard Ratio (95% CI) All Causes of Death
All Cases Combined	2,302	86.0	
<i>Race</i>			
Non-Hispanic white women	2,092	87.1	1.00 (reference)
Non-Hispanic black women	210	75.3	2.11 (1.57–2.83)
<i>Treatment</i>			
<i>Primary Therapy</i>			
Breast-conserving surgery with radiation	950	91.4	1.00 (reference)
Mastectomy	1,021	83.2	2.04 (1.58–2.63)
Breast-conserving surgery only	331	76.9	3.02 (2.24–4.07)
<i>Hormone Therapy<sup>1,2</sup></i>			
ER+/PR+ and received hormone therapy	836	91.3	1.00 (reference)
ER+/PR+ and not received hormone therapy	643	86.4	1.55 (1.15–2.08)
ER- & PR- and received hormone therapy	64	78.1	2.56 (1.45–4.52)
ER- & PR- and not received hormone therapy	280	77.6	2.66 (1.92–3.68)
Unknown receptor status and received hormone therapy	132	83.6	1.76 (1.09–2.85)
Unknown receptor status and not received hormone therapy	284	82.5	2.01 (1.41–2.87)
Unknown if received hormone therapy	63	75.1	3.63 (1.88–6.99)
<i>Multiagent Chemotherapy</i>			
Size >3 cm and received chemotherapy	78	77.4	1.00 (reference)
Size >3 cm and not received chemotherapy	108	73.2	1.18 (0.66–2.09)
Size ≤3 cm and ER-&PR- and received chemotherapy	118	83.7	0.64 (0.34–1.20)
Size ≤3 cm and ER-&PR- and not received the chemotherapy	141	75.4	1.11 (0.64–1.92)
Size ≤3 cm and ER+/PR+ and received chemotherapy	221	93.8	0.27 (0.14–0.52)
Size ≤3 cm and ER+/PR+ and not received chemotherapy	1,455	87.3	0.51 (0.32–0.82)
Unknown size/chemotherapy or size<3 cm and unknown hormone receptor status	181	88.1	0.46 (0.24–0.87)
<i>Tumor Characteristics</i>			
<i>Tumor Size (cm)</i>			
<1	520	91.8	1.00 (reference)
1–3	1,488	85.3	2.03 (1.46–2.81)
>3	194	74.0	3.81 (2.54–5.72)
Unknown	100	90.1	1.32 (0.66–2.64)
<i>Estrogen and Progesterone Receptor</i>			
Negative hormone receptor (ER - and PR -)	346	77.5	1.00 (reference)
Positive hormone receptor (ER+ or PR+)	1,523	88.8	0.39 (0.30–0.51)
Unknown ER, PR	433	83.0	0.56 (0.40–0.77)

ment for age at diagnosis. Marital status had the least influence on the racial difference after controlling for age. After adjusting for age and comorbidity, the hazard ratio of NHB women versus NHW women was reduced from 2.35 to 2.03 (95% CI: 1.51–2.74). After controlling for tumor characteristics—tumor size, hormone receptor status and tumor grade—the hazard ratio dropped to 1.67 (95% CI: 1.24–2.26). Further adjustment for health insurance and marital status, after controlling for all the above variables, reduced the hazard ratio to 1.55 (95% CI: 1.14–2.13). When treatment variables (presented in Table 1) were added to the model, the hazard ratio was further reduced to 1.38 (95% CI: 1.00–1.91). A borderline significant survival difference between NHB and NHW women remained in the final model.

**DISCUSSION**

This is the first study to examine the dissemination and practice of guideline-based therapy in the community and its impact on survival using data collected

through the patterns of care study conducted by population-based cancer registries in both SEER and NPCR areas, covering both urban and rural settings. Our findings indicate that NHB women were less likely than NHW women to receive guideline-concordant hormonal therapy and radiation therapy but were more likely to receive chemotherapy. Racial disparities in cancer treatment partially explain worse survival of NHB women as compared with NHW women. Reducing disparities in cancer care in the community would further reduce racial differences in survival.

Compared with NHW women, black women were more likely to undergo mastectomy. Among those who underwent breast conserving surgery, NHB women were less likely than NHW women to receive radiation therapy. Our finding is consistent with previous studies.<sup>3,23,24</sup> One previous study using SEER–Medicare-linked data reported that after controlling for comorbidity and supply of primary care physicians and radiation oncologists, the black–white difference in receiving radiation therapy was

**Table 1. continued**

Characteristic	Number	5-Year Survival (%)	Hazard Ratio (95% CI) All Causes of Death
<b>Tumor Grade</b>			
Well differentiated	481	90.1	1.00 (reference)
Moderately differentiated	439	88.1	1.19 (0.86–1.67)
Poorly differentiated	543	80.5	1.99 (1.43–2.78)
Undifferentiated	14	77.8	2.28 (0.71–7.30)
Unknown	425	84.9	1.50 (1.04–2.16)
<b>Sociodemographics</b>			
<b>Age (Years)</b>			
<50	485	92.7	1.00 (reference)
50–59	512	92.4	1.07 (0.68–1.68)
60–69	533	90.1	1.32 (0.86–2.04)
≥70	772	74.3	4.05 (2.83–5.80)
<b>Marital Status</b>			
Married	1,280	90.5	1.00 (reference)
Single	220	90.3	1.19 (0.78–1.83)
Other <sup>3</sup>	723	76.7	2.63 (2.09–3.31)
Unknown	79	87.1	1.27 (0.66–2.41)
<b>Comorbidity (Charlson Index Score)</b>			
0	1,997	88.9	1.00 (reference)
1	243	74.7	2.60 (1.98–3.42)
≥2	62	37.4	6.98 (4.93–9.88)
<b>Health insurance</b>			
Private <sup>4</sup>	1,755	87.6	1.00 (reference)
Public <sup>5</sup>	320	76.2	2.16 (1.67–2.80)
Insurance, NOS	73	90.4	0.68 (0.32–1.44)
None	50	88.8	0.81 (0.33–1.96)
Unknown	104	84.3	1.34 (0.83–2.17)

CI: Confidence interval; ER: Estrogen receptor; PR: Progesterone receptor; NOS: Not otherwise specified; SES: Socioeconomic status; POC: Pattern of care; \* All women included were followed through December 31, 2002; 1. Either estrogen receptor or positive progesterone receptor was positive; 2. Both estrogen receptor and progesterone receptor were negative; 3. Includes separated, divorced and widowed; 4. Includes those with private insurance only or private insurance supplemented to public insurance; 5. Includes Medicare, Medicaid or welfare, and other federally funded insurance.

**Table 2. Distribution of select characteristics by race/ethnicity among women diagnosed with localized breast cancer in 1997 (Centers of Disease Control and Prevention Patterns of Care study)**

Characteristics	Non-Hispanic Whites		Non-Hispanic Blacks		P Value
	Count	%	Count	%	
All Cases Combined	2,092	100.0	210	100.0	
<i>Cancer Treatment</i>					
<i>Primary Therapy</i>					
Breast-conserving surgery with radiation	948	45.3	73	34.8	0.008
Mastectomy	853	40.7	97	46.2	
Breast-conserving surgery only	291	13.9	40	19.1	
<i>Hormone Therapy</i>					
Received	974	46.6	58.0	27.6	<0.0001
Not received	1,063	50.8	144	68.6	
Unknown	55	2.6	8	3.8	
<i>Multiagent Chemotherapy</i>					
Received	368	17.6	58	27.6	<0.0001
Not received	1,659	79.3	131	62.4	
Unknown	65	3.1	21	10.0	
<i>Tumor Characteristics</i>					
<i>Tumor Size (cm)</i>					
<1	496	23.7	24	11.4	
1–3	1,349	64.5	139	66.2	<0.0001
>3	156	7.5	38	18.1	
Unknown	91	4.4	9	4.3	
<i>Estrogen and Progesterone Receptor</i>					
Negative hormonal receptor (ER - and PR -)	285	13.6	61	29.1	
Positive hormonal receptor (ER+ or PR+)	1,427	68.2	96	45.7	<0.0001
Unknown ER, PR	380	18.2	53	25.2	
<i>Tumor Grade</i>					
Well differentiated	450	21.5	31	14.8	
Moderately differentiated	775	37.0	64	30.5	0.0013
Poorly differentiated	474	22.7	69	32.9	
Undifferentiated	11	0.5	3	1.4	
Unknown	382	18.3	43	20.5	
<i>Sociodemographics</i>					
<i>Age (Years)</i>					
<50	415	19.8	70	33.3	
50–59	463	22.1	49	23.3	<0.0001
60–69	501	23.9	32	15.2	
≥70	713	34.1	59	28.1	
<i>Marital Status</i>					
Married	1,202	57.5	49	23.3	
Single	171	8.2	78	37.1	<0.0001
Other <sup>1</sup>	655	31.3	68	32.4	
Unknown	64	3.1	15	7.1	
<i>Comorbidity (Charlson Index Score)</i>					
0	1,823	87.1	174	82.9	0.0416
1	218	10.4	25	11.9	
≥2	51	2.4	11	5.2	
<i>Health Insurance</i>					
Private <sup>2</sup>	1,633	78.1	122	58.1	
Public <sup>3</sup>	268	12.8	52	24.8	
Insurance, NOS	69	3.3	4	1.9	
None	33	1.6	17	8.1	<0.0001
Unknown	89	4.3	15	7.1	

NHW: Non-Hispanic white; NHB: Non-Hispanic black; ER: Estrogen receptor; PR: Progesterone receptor; NOS: Not otherwise specified; SES: Socioeconomic status; POC: pattern of care; 1. Includes separated, divorced and widowed; 2. Includes those with private insurance only or private insurance supplemented to public insurance; 3. Includes Medicare, Medicaid or welfare, and other federally funded insurance

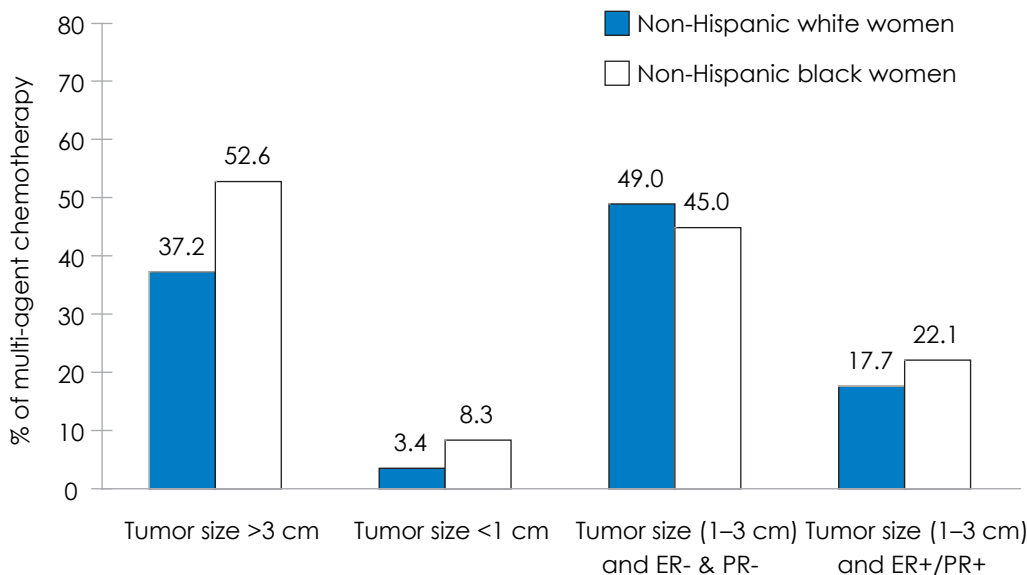
reduced substantially, indicating comorbidity and lower supply of radiation oncologists may contribute to the lower use of radiation therapy with breast-conserving surgery among black women compared with white women.<sup>24</sup> Other factors such as travel distance to the radiation therapy center, transportation and patient preference may also contribute to this racial difference in radiation therapy use after breast-conserving surgery.<sup>25,26</sup>

NHB women were less likely than NHW women to receive guideline-concordant hormonal therapy in this study but more likely to receive chemotherapy. Information on utilization of guideline-based adjuvant therapy by race is scarce in the literature. One study using hospital-based data reported that black women were less likely than white women to receive guideline-concordant hormonal therapy and chemotherapy.<sup>23</sup> Data from a SEER POC study also suggests that black women receive less adjuvant therapy than white women.<sup>27</sup> The published data from SEER POC studies, however, did not separate hormonal therapy from chemotherapy by race. The 1995 SEER data show that 18% of early-stage breast cancer patients received multiagent chemotherapy and 34% of the patients received hormonal therapy, while our data for early-stage breast cancer patients diagnosed in 1997 show that 19% of the patients received multiagent chemotherapy and 45% of them received hormonal therapy. The disparities may be attributable to differences in the time period under study and geographic coverage or treating facilities as well as characteristics of cancer

cases included in the studies. Because black women are more likely to have low socioeconomic status and to have either publicly provided health insurance or no health insurance at all, they may be less likely to be referred for oncology consultations.<sup>23,26,28</sup> Earlier studies reported that patients who were referred to medical oncologists were more likely to receive the standard adjuvant therapies.<sup>29</sup> It was noted that few racial/ethnic disparities in cancer treatment were found in studies of single-institution and equal-access systems.<sup>30</sup> However, one of the findings from our study does not fit in this picture—that is NHB women were more likely than NHW to receive chemotherapy. One possible explanation is related to NHB women's being more likely than NHW women to have hormone receptor-negative tumors. Since hormonal therapy was not known to improve the prognosis for women with hormone receptor-negative tumors, chemotherapy was the only systemic treatment option for this subset of women.

Our data further confirm that breast cancers among NHB women are more likely than those diagnosed in NHW women to be large, have negative hormone receptor status and be of higher grade. NHB women also have a greater number of comorbidities. Although the adverse tumor biology and higher comorbidity among NHB women contribute to racial disparities in prognosis, these factors only partially explain the difference we observed in the present study. Consistent with previous studies,<sup>8,31</sup> we found that the risk of death from all causes

**Figure 1. Percentage of multiagent chemotherapy among women with localized breast cancer by race, tumor size and hormone receptor status in 1997**



Source: The Centers for Disease Control and Prevention's National Program of Cancer Registries Patterns of Care study. Data were from seven population-based state cancer registries (California, Colorado, Illinois, Louisiana, New York, Rhode Island and South Carolina).

was still higher for NHB women than NHW women after controlling for tumor biology and comorbidity.

We found that women who underwent breast-conserving surgery with radiation therapy had a lower risk of death than those who underwent breast-conserving surgery without radiation therapy, and women with hormone receptor-positive tumors who received hormonal therapy had a lower risk of death than their counterparts who did not receive hormonal therapy. In contrast, our data show that hormonal therapy had no impact on the risk of death for women with hormone receptor-negative tumors, confirming the current guidelines on the absence of hormonal therapy for receptor-negative tumors. Our data also show that multiagent chemotherapy reduced the risk of death for women, regardless of tumor size. These results are concordant with the current guidelines for breast cancer care.<sup>19</sup>

Our data indicate that the poorer prognosis noted among NHB women was partially attributable to differences in receiving guideline-concordant primary and adjuvant therapies. After controlling for age at diagnosis, comorbidity, tumor characteristics, marital status and health insurance, additionally adjusting for primary and adjuvant therapies further reduced the racial difference in the risk of death. Randomized controlled clinical trials in women with breast cancer have suggested that the combination of monitoring patients and performing standardized treatment yields equal survival rates for black and white women with the same stage at diagnosis,<sup>32,33</sup> indicating that the black–white difference in survival may be partially attributable to differences in treatment. Although the racial difference in risk of death was reduced considerably after controlling for

all study variables in the present study, it was still higher among NHB women than NHW women, implying there are still residual effects of the adjusted variables, or that other variables may contribute to the racial differences in prognosis. Researchers presenting recent analyses of the increasing gap in survival between black and white women concluded that this might be due to unequal access to the newest therapies.<sup>34</sup> Previous studies have reported that black women are more likely than white women to receive lower chemotherapy doses and to terminate treatment prematurely.<sup>1,10</sup> Black women were also more likely than white women to receive nonstandard adjuvant chemotherapy regimens.<sup>35</sup> Lowering the dose intensity of adjuvant therapy and nonstandard chemotherapy regimens for breast cancer reduces the effectiveness of the treatment.<sup>1</sup> Since information on chemotherapy regimens and dose as well as toxicity and side effects was not available for the present study, their contribution to the racial difference in risk of death could not be assessed.

Several limitations of this study must be noted. First, because this study collected only the comorbidity that had been coded on the face sheets of the women's medical records, comorbidity may have been underestimated. Our adjustment for comorbidity may not have completely removed the effect of other diseases on the racial difference in risk of death from all causes. Second, because information on breast cancer specific cause of death was not available for a high proportion of the women included, we were not able to perform cause-specific survival analysis. Third, the lack of information on chemotherapy regimen and dose intensity limited our ability to assess chemotherapy's impact on racial difference

**Table 3. Risk of death among black women with localized breast cancer compared with white counterparts in selected proportional hazards survival models<sup>1</sup>**

Variables in Model <sup>1</sup>	Hazard Ratio (95% CI)
	All Causes of Death
Race	2.35 (1.75–3.16)
Race, comorbidity	2.03 (1.51–2.74)
Race, tumor characteristics <sup>2</sup>	1.87 (1.38–2.53)
Race, health insurance	2.16 (1.60–2.93)
Race, treatment <sup>3</sup>	1.83 (1.35–2.48)
Race, primary therapy	2.20 (1.64–2.96)
Race, hormonal therapy	1.96 (1.45–2.65)
Race, chemotherapy	1.99 (1.47–2.70)
Race, marital status	2.34 (1.73–3.16)
Race, comorbidity, tumor characteristics <sup>2</sup>	1.67 (1.24–2.26)
Race, comorbidity, tumor characteristics, health insurance	1.56 (1.15–2.12)
Race, comorbidity, tumor characteristics, health insurance, marital status	1.55 (1.14–2.13)
Race, comorbidity, tumor characteristics, <sup>2</sup> health insurance, marital status, and treatment	1.38 (1.00–1.91)

\* All women included were followed through December 31, 2002; 1: All models were adjusted for age; 2: Tumor characteristics: tumor size, tumor grade and estrogen receptor/progesterone receptor status; 3 Treatment included primary care (surgery, radiation), hormone therapy and chemotherapy. See Table 2 for the categories of the variables included in these models.

in prognosis. Fourth, because the sample cases were randomly selected from study populations, the number of NHB women included was relatively small, which prevented us from performing more in-depth analysis.

Despite these limitations, this study provides valuable information on how guideline-based therapy was disseminated in the community and its possible impact on racial differences in survival. With available cancer screening tools for early detection of breast cancer, the proportion of women diagnosed with early-stage breast cancer has increased over time. For these women, long-term survival is possible with available therapies that meet established guidelines and have been demonstrated to reduce cancer recurrence and increase survival.<sup>36</sup> Unfortunately, guideline-concordant therapies are disproportionately delivered across racial/ethnic populations. Although comorbidity may prevent some patients from receiving optimal treatment, it is obvious that some nonclinical factors such as health insurance and access to care also create barriers to receiving guideline-concordant care. To successfully design interventions to reduce disparities, the underlying cause must be identified. This study illustrates the efforts of the CDC's NPCR to enhance data currently collected from cancer registries for addressing disparities in the care of cancer patients. Coordinated, systematic and strategic plans are needed to overcome identified differential delivery of treatment across racial/ethnic groups in order to reduce disparities in cancer patient care.

## REFERENCES

- Hershman D, McBride R, Jacobson JS, et al. Racial disparities in treatment and survival among women with early-stage breast cancer. *J Clin Oncol*. 2005;23:6639-6646.
- Chu KC, Lamar CA, Freeman HP. Racial disparities in breast carcinoma survival rates: separating factors that affect diagnosis from factors that affect treatment. *Cancer*. 2003;97:2853-2860.
- Joslyn SA. Racial differences in treatment and survival from early-stage breast carcinoma. *Cancer*. 2002;95:1759-1766.
- Eley JW, Hill HA, Chen VW, et al. Racial differences in survival from breast cancer. Results of the National Cancer Institute Black/White Cancer Survival Study. *JAMA*. 1994;272:947-954.
- Joslyn SA. Hormone receptors in breast cancer: racial differences in distribution and survival. *Breast Cancer Res Treat*. 2002;73:45-59.
- Chen VW, Correa P, Kurman RJ, et al. Histological characteristics of breast carcinoma in blacks and whites. *Cancer Epidemiol Biomarkers Prev*. 1994;3:127-135.
- Field TS, Buist DS, Doubeni C, et al. Disparities and survival among breast cancer patients. *J Natl Cancer Inst Monogr*. 2005:88-95.
- Woodward WA, Huang EH, McNeese MD, et al. African-American race is associated with a poorer overall survival rate for breast cancer patients treated with mastectomy and doxorubicin-based chemotherapy. *Cancer*. 2006;107:2662-2668.
- Smedley B, Stith A, Nelson A, eds. Unequal treatment - confronting racial and ethnic disparities in health care. Washington DC: Institute of Medicine, National Academy Press, 2003.
- Griggs JJ, Sorbero ME, Stark AT, et al. Racial disparity in the dose and dose intensity of breast cancer adjuvant chemotherapy. *Breast Cancer Res Treat*. 2003;81:21-31.
- Hershman DL, Wang X, McBride R, et al. Delay in initiating adjuvant radiotherapy following breast conservation surgery and its impact on survival. *Int J Radiat Oncol Biol Phys*. 2006;65:1353-1360.
- Li CI, Malone KE, Daling JR. Differences in breast cancer stage, treatment, and survival by race and ethnicity. *Arch Intern Med*. 2003;163:49-56.
- Simon MS, Banerjee M, Crossley-May H, et al. Racial differences in breast cancer survival in the Detroit Metropolitan area. *Breast Cancer Res Treat*. 2006;97:149-155.
- Warren JL, Harlan LC. Can cancer registry data be used to study cancer treatment? *Med Care*. 2003;41:1003-1005.
- SEER (Surveillance Epidemiology and End Results Program). The SEER Program Code Manual, ed. 3rd ed. Bethesda, MD: National Institutes of Health, National Cancer Institute; 1999.
- McDavid K, Schymura MJ, Armstrong L, et al. Rationale and design of the National Program of Cancer Registries' Breast, Colon, and Prostate Cancer Patterns of Care Study. *Cancer Causes Control*. 2004;15:1057-1066.
- NIH (National Institute of Health). Clinical alert from the national cancer institute. *Breast Cancer Res Treat*. 1988;12:3-5.
- Anonymous. NIH consensus conference. Treatment of early-stage breast cancer. *JAMA*. 1991;265:391-395.
- Anonymous. National Institute of Health Consensus Development Conference statement: adjuvant therapy for breast cancer, November 1-3, 2000. *J Natl Cancer Inst Monogr*. 2001:5-15.
- Havener L, Hultstrom D, eds. Standards for Cancer Registries Volume II: Data Standards and Data Dictionary, 9th ed, Version 10.2. Springfield, IL: North American Association of Central Cancer Registries, March 2004.
- Charlson ME, Pompei P, Ales KL, et al. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987;40:373-383.
- Allison PD. *Survival Analysis Using the SAS System: A Practical Guide*. Cary, NC: SAS Institute Inc.; 1995.
- Bickell NA, Wang JJ, Oluwole S, et al. Missed opportunities: racial disparities in adjuvant breast cancer treatment. *J Clin Oncol*. 2006;24:1357-1362.
- Ballard-Barbash R, Potosky AL, Harlan LC, et al. Factors associated with surgical and radiation therapy for early stage breast cancer in older women. *J Natl Cancer Inst*. 1996;88:716-726.
- Athas WF, Adams-Cameron M, Hunt WC, et al. Travel distance to radiation therapy and receipt of radiotherapy following breast-conserving surgery. *J Natl Cancer Inst*. 2000;92:269-271.
- Bickell NA, McEvoy MD. Physicians' reasons for failing to deliver effective breast cancer care: a framework for underuse. *Med Care*. 2003;41:442-446.
- Harlan L, Abrams J, Warren J, et al. Adjuvant therapy for breast cancer: practice patterns of community physicians. *J Clin Oncol*. 2002;20:1809-1817.
- Bradley CJ, Given CW, Roberts C. Race, socioeconomic status, and breast cancer treatment and survival. *J Natl Cancer Inst*. 2002;94:490-496.
- Mandelblatt JS, Hadley J, Kerner JF, et al. Patterns of breast carcinoma treatment in older women: patient preference and clinical and physical influences. *Cancer*. 2000;89:561-573.
- Heimann R, Ferguson D, Powers C, et al. Race and clinical outcome in breast cancer in a series with long-term follow-up evaluation. *J Clin Oncol*. 1997;15:2329-2337.
- Shen Y, Dong W, Esteva FJ, et al. Are there racial differences in breast cancer treatments and clinical outcomes for women treated at M.D. Anderson Cancer Center? *Breast Cancer Res Treat*. 2007;102:347-356.
- Roach M III, Cirincione C, Budman D, et al. Race and survival from breast cancer: based on Cancer and Leukemia Group B trial 8541. *Cancer J Sci Am*. 1997;3:107-112.
- Dignam JJ. Efficacy of systemic adjuvant therapy for breast cancer in African-American and Caucasian women. *J Natl Cancer Inst Monogr*. 2001(30):36-43.
- Jatoi I, Anderson WF, Rao SR, et al. Breast cancer trends among black and white women in the United States. *J Clin Oncol*. 2005;23:7836-7841.
- Griggs JJ, Culakova E, Sorbero ME, et al. Social and racial differences in selection of breast cancer adjuvant chemotherapy regimens. *J Clin Oncol*. 2007;25:2522-2527.
- Berry DA, Cronin KA, Plevritis SK, et al. Effect of screening and adjuvant therapy on mortality from breast cancer. *N Engl J Med*. 2005;353:1784-1792. ■