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Parity and disparity in first course treatment of invasive breast cancer

Mary Jo Lund · Otis P. Brawley · Kevin C. Ward · John L. Young · Sheryl S. G. Gabram · J. William Eley

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Abstract *Background* Adherence to first course treatment guidelines for breast cancer may not be uniform across racial/ethnic groups and could be a major contributing factor to disparities in outcome. In this population-based study, we assessed racial differences in initial treatment of breast cancer. *Methods* Surveillance, Epidemiology, and End Results (SEER) program data were used to study all primary invasive breast cancers diagnosed during 2000–2001 among Black (n = 877) and White (n = 2437) female residents of the five Atlanta SEER counties, counties with several large teaching hospitals. Differences in treatment delay, cancer directed surgery, and receipt of chemotherapy, radiotherapy, or hormonal therapy were analyzed according to guidelines for treatment. Analyses utilized frequency distributions, χ^2 tests of independence and statistics in and across strata. *Results* Black women experienced longer treatment delays, regardless of stage at diagnosis, and were 4–5 fold more likely to experience delays greater than 60 days ($P < 0.001$). For local–regional disease, more Black women did not receive cancer directed surgery (7.5% vs. 1.5% of white women, $P < 0.001$), but did receive breast conserving surgery (BCS) equivalently. Only 61% of Black vs. 72% of White women received radiation with BCS ($P < 0.001$). Black women eligible for hormonal therapy were less likely to receive it ($P < 0.001$). *Conclusion* Our findings suggest treatment standards are not adequately or equivalently met among Black and White women, even in an area where teaching hospitals provide a substantial portion of breast cancer care. Treatment differences can adversely affect outcome and reasons for the differences need to be addressed.

Keywords Breast neoplasms · Racial disparity · Treatment

Abbreviations

BCS	Breast Conserving Surgery
ER	Estrogen Receptor
PR	Progesterone Receptor
+	Positive
SEER	Surveillance, Epidemiology, and End Results
NOS	Not otherwise specified

Introduction

It is estimated that in 2006 about 41,000 women in the U.S. died from breast cancer and a disproportionate number

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M. J. Lund (✉) · O. P. Brawley · K. C. Ward · J. L. Young
Department of Epidemiology, Rollins School of Public Health, Emory University, Atlanta, GA 30322, USA
e-mail: mlund@sph.emory.edu

M. J. Lund · O. P. Brawley · J. W. Eley
Winship Cancer Institute, Emory University School of Medicine, Atlanta, GA, USA

M. J. Lund · O. P. Brawley · S. S. G. Gabram
Georgia Cancer Center for Excellence at Grady, Atlanta, GA, USA

M. J. Lund · O. P. Brawley · S. S. G. Gabram · J. W. Eley
Emory University School of Medicine, Atlanta, GA, USA

K. C. Ward · J. L. Young
Georgia Center for Cancer Statistics, Atlanta, GA, USA

were black [1]. This excess in mortality is a reflection of the markedly poorer survival experienced by black women, which has persisted for decades [2]. Major reasons for this disparity have been attributed to the increased number of black women diagnosed at later stage of disease and at an earlier age, where breast cancers tend to be more aggressive and result in poorer outcomes. Nationally, racial differences in survival continue even within stage and age groups [3–6]. Other factors which may contribute to this disparity include socioeconomic and demographic factors, cultural beliefs, health care access, co-morbid conditions, and tumor biology [7–19]. Another factor may be differences in delivery of cancer treatment. Adherence to established treatment guidelines may not be uniform across racial/ethnic groups and differences in treatment may be a major contributing factor to racial disparities in outcome [5, 14, 20–22].

Clinical practice guidelines for first course treatment of invasive breast cancer are well-established [23–25]. Some studies suggest that U.S. black women diagnosed with breast cancer are less likely to receive treatments concordant with established guidelines [26–28]. Several have reported racial differences in treatment delay, prescription, utilization, and response [29–32]. Black women may less frequently receive first course surgical and radiation treatment according to recommended guidelines [20, 27, 33, 34] and more frequently may not receive any surgery, even after accounting for a greater prevalence of inoperable cancers [21]. The benefits of adjuvant therapies to improving outcomes are clear [35, 36]. Appropriate use of adjuvant therapies reduce the risk of recurrence and improve chances for long-term survival. However, some studies suggest that black women are less likely to receive appropriate chemotherapy [37–42]. Whether black women are less likely to receive hormonal therapy remains equivocal [10, 39, 43]. It is established that black women have a lower incidence of Estrogen receptor positive and/or progesterone receptor positive (ER+/PR+) tumors and thus for a higher proportion of black women, hormonal therapy would not be indicated [44–46]. However, the prescription of hormonal therapy in published studies has not been studied separately among hormone receptor positive patients, who should be offered hormonal therapy, and negative patients, who should not. Treatment may also differ by health system providers [27, 28].

To assess racial differences in the initial treatment of invasive breast cancer, we used data from the Atlanta Surveillance, Epidemiology, and End Results (SEER) Registry. In this population-based study, we focused on the five metropolitan Atlanta SEER counties, an area with a sizeable black population and where large teaching hospitals are located.

Methods

Data collection and description

Data were obtained from the Atlanta SEER Registry of the National Cancer Institute, which has collected population-based cancer data in the metropolitan Atlanta area since 1975. All female invasive breast cancer cases (ICD-O site codes C50.0–C50.9, behavior code 3) [47] diagnosed among residents of the five Atlanta SEER counties (Fulton, Dekalb, Cobb, Clayton, and Gwinnett) from January 1, 2000 to December 31, 2001 were included. A small percentage of women who reported race as neither black nor white were excluded (2.1%). Patients diagnosed only by death certificate or autopsy were also excluded.

Treatment factors analyzed included type of first course treatment, delay in first course treatment, delivery of cancer directed surgery, type of surgery, and receipt of chemotherapy, radiotherapy, or hormonal therapy. Categories presented are based on treatment guidelines [23, 24, 48, 49]. The delay interval was calculated by subtracting the date of diagnosis from the earliest date of first course treatment; surgery, neoadjuvant chemotherapy, or initiation of chemotherapy or radiation therapy for distant metastatic disease. The delay groups were then established based on guidelines and literature review. Type of surgery was categorized into two groups, breast conserving surgery (BCS) or mastectomy. BCS included excisional biopsy/lumpectomy, wedge resection, quadrectomy, tylectomy, and segmented or sub-cutaneous mastectomy. Mastectomy included simple, modified, radical, and NOS (not otherwise specified), with or without removal of the uninvolved contralateral breast. Adjuvant treatments (radiotherapy, chemotherapy, and hormonal therapy) were dichotomized into receipt/no receipt categories.

Racial differences in treatment were analyzed according to their basis for treatment, based on stage at diagnosis, age at diagnosis, and specific tumor characteristics. Race in the SEER data is abstracted from the medical record and supplemented, where missing, from additional sources. Stage at diagnosis was presented according to the SEER Summary Staging guidelines using the broad categories of local, regional, or distant disease [50]. Age at diagnosis was categorized into three groups (18–50, 51–70, and > 70) according to age-specific treatment criteria. ER and PR status were categorized as positive (+) which included borderline, negative (–), or unknown. Tumor size, number of positive nodes, and nodal status were collected using SEER Extent of Disease guidelines [51] and grouped according to the AJCC Cancer Staging Manual [52] and treatment criteria [23, 24, 48, 49]. Grade represents the degree of tumor cell differentiation; defined as highly (Grade 1), moderately (Grade 2), or poorly (Grade 3)

differentiated. In the absence of a stated differentiation, the Bloom–Richardson grading scheme was used [53].

Statistical analyses

Frequency distributions and χ^2 tests of independence were used to describe the study population by race as well as to examine racial differences in treatment within stage groups. In order to examine racial differences in treatment according to recommended guidelines, the race–treatment relationships were then stratified on selected age groups, disease and tumor characteristics, and other treatments. Frequency distributions, χ^2 tests of independence, and Cochran–Mantel–Haenszel statistics were utilized to analyze the racial differences in and across strata. Unknown categories for all variables were kept in the analyses. *P*-values reflect analyses with and without unknown categories included.

Results

Table 1 displays population and tumor characteristics by race. The study population was 26.5% black and 73.5% white. Most of the black cancer patients resided in the counties of Fulton and Dekalb (75.9%), while the majority of white patients were from Cobb, Fulton, and Gwinnett counties (75.5%). Black women were highly more likely than white women to be diagnosed at age 50 or younger (45.3% vs. 27.3%). The reverse was true for women over age 70 (15.3 vs. 24.7% respectively). Black women were also more likely to be diagnosed at later stage; 48.4% were diagnosed with regional or distant disease vs. 33.9% for white women. The tumors of black women were also much more frequently larger size, ER–, PR–, and high grade. The proportion of women diagnosed with four or more positive regional nodes was also higher, as was the percentage of women with nodes not examined (20.0% for black women vs. 11.8 % for white women). The status of a large proportion of the tumor characteristics was unknown, but these differences did not appear to differ significantly by race, with the exception of tumor size and grade. Within each of the 5 Atlanta SEER counties, the results were consistent with the overall results reported (data not shown). Within stage groups, most of the racial differences also remained (data not shown). The only exception was among those diagnosed with distant disease; differences in PR or grade status were not observed.

Racial differences in first course treatment, within stage, are presented in Table 2. Between 21 and 27% of the women received treatment on the same day of diagnosis, primarily surgery. Black women were more likely than white women to experience delays greater than 30 days, regardless of stage at diagnosis. The delay for the majority of black women was greater than two weeks and black women were 4- to 5-fold more likely to experience delays greater than 60 days.

Most women diagnosed with local-regional disease received surgery as their first type of treatment within the spectrum of first course therapy, but racial differences were observed (Table 2). While chemotherapy was the first type of treatment received for a relatively small proportion of women, black women were more than twice as likely as white women to first receive chemotherapy at any stage of disease.

Greater than 90% of both black and white women diagnosed with either local or regional disease received surgery (Table 2), but surgery was significantly less often performed on black women (Table 2). However, of those who received surgery, there were no racial differences observed for type of surgery, about 65% of women with local disease received BCS and over 40% with regional disease. Racial differences in nodal scope of surgery and number of nodes examined were also present. Among women with local or regional disease, black women were more likely to not have any lymph nodes examined and less likely to have sentinel lymph node biopsies. However, among those who did have lymph nodes examined, more black women had greater than 10 nodes examined.

Tables 3 and 4 exhibit racial differences in surgical procedures and radiation, restricted to women diagnosed with local or regional disease. Black women were less likely than white women to receive surgery for tumors larger than 1.0 cm (Table 3). Black women were also less likely to receive surgery within each age group. Despite these differences in administration of surgery, racial differences in type of surgery by tumor size or age group were not observed.

Overall, about 62% of black women and 72% of white women received radiotherapy after BCS ($P < 0.001$) (Table 4). For patients diagnosed prior to age 71, black women less often received radiotherapy after BCS. When stratified by tumor size, a lower proportion of black women received BCS-radiation, but only for tumors < 2.0 cm. Among women with tumors larger than 5.0 cm treated with mastectomy, black women were also less likely to receive radiotherapy. Black women were also less likely to receive combined BCS—radiotherapy when less than 4 nodes were positive or mastectomy—radiotherapy when 4 or more nodes were positive.

Table 5 shows no racial differences in chemotherapy receipt among women diagnosed with node-positive local or regional disease (72.9% and 70.8% of black and white women received chemotherapy), but younger women were more likely than older women to receive chemotherapy. Black women were more likely than white women,

Table 1 Population and tumor characteristics by race for women diagnosed with invasive breast cancer, Atlanta, GA, 2000–2001

	Black		White		
	877	26.5%	2437	73.5%	*P*-value
	N	Col %[a]	N	Col %[a]	
County[b]					<0.0001
Fulton	345	39.3	610	25.0	
Dekalb	321	36.6	460	18.9	
Clayton	96	11.0	145	6.0	
Cobb	70	8.0	660	27.1	
Gwinnett	45	5.1	562	23.1	
Age at diagnosis[b]					<0.001
> 70	134	15.3	601	24.7	
51–70	346	39.5	1171	48.1	
18–50	397	45.3	665	27.3	
Stage[b]					<0.0001
Local	427	48.7	1571	64.5	<0.0001*
Regional	351	40.0	735	30.2	
Distant	74	8.4	90	3.7	
Unknown	25	2.9	41	1.7	
Tumor size (cm)[b]					<0.0001
0.1–1.0	173	19.7	702	28.8	<0.0001*
1.1–2.0	256	29.2	936	38.4	
2.1–5.0	250	28.5	569	23.4	
5.1–14.0	86	9.8	91	3.7	
Diffuse/inflammatory	23	2.6	19	0.8	
Unknown	89	10.2	120	4.9	
Nodal status[b]					<0.0001
N0	462	52.7	1600	65.7	<0.0001*
N1	330	37.6	704	28.9	
N2	21	2.4	23	0.9	
N3	5	0.6	4	2.0	
Unknown	59	6.7	106	4.4	
Number positive regional lymph nodes[b]					<0.0001
0	365	42.8	1386	57.8	<0.0001*
1–3	167	19.6	491	20.5	
4–9	94	11.0	146	6.1	
10+	42	4.9	72	3.0	
Positive (unknown #)	9	1.1	4	0.2	
Not examined	170	20.0	283	11.8	
Unknown	5	0.6	14	0.6	
ER[b]					<0.0001
Positive	435	49.6	1635	67.1	<0.0001*
Negative	285	32.5	392	16.1	
Not ordered; not performed	42	4.8	115	4.7	
Unknown	115	13.2	295	12.1	
PR[b]					<0.0001
Positive	369	42.1	1391	57.1	<0.0001*
Negative	347	39.6	630	25.8	
Not ordered; not performed	43	4.9	118	4.8	
Unknown	118	13.5	298	12.2	

Table 1 continued

	Black		White		
Grade[b]					<0.0001
I	88	10.0	445	18.3	<0.0001*
II	262	29.9	1017	41.7	
III	386	44.0	713	29.3	
Unknown	141	16.1	262	10.8	
Histology					<0.0001
Ductal	665	75.8	1764	72.4	
Lobular	41	4.7	204	8.4	
Mixed ductal & lobular	34	3.9	171	7.0	
Tubular, mucinous, medullary	12	1.4	10	0.4	
Inflammatory	17	1.9	18	0.7	
Other	108	2.3	270	11.1	

[a] Percents may not sum to 100 due to rounding

[b] Within counties and stage groups, racial differences were consistent with overall results reported

**P*-value with unknowns, not examined, not ordered, or not performed deleted

however, to receive chemotherapy for node negative disease (34.6% vs. 26.3% respectively). Among node-negative patients, the majority of women with smaller tumors that were either higher grade or ER–PR– did not receive chemotherapy.

A minority of women received hormone therapy for ER and/or PR positive disease, regardless of age (Table 6). Striking racial differences were also observed. Overall, black women were about 40% as likely to receive hormonal treatment for tumors that were ER and/or PR positive, and this was consistent within all age groups under 71.

Discussion

Although adherence to established treatment guidelines were relatively high for all women, black women were less likely to receive the recommended stage and tumor characteristic specific surgical, radiation, and hormonal treatments and were more likely to experience delays in treatment. No differences were observed for receipt of chemotherapy.

Delay

In our study, black women were more likely to experience treatment delays, particularly very long delays, within any given stage. Median time to treatment decreased as stage progressed, but significant racial differences remained. Several studies have reported that black women are more likely to experience delays in treatment; delays that are not explained away by demographic and clinical factors [29–31]. These delays appear to be especially prevalent among younger women [30, 31]. In our study although the racial differences in delay were equivalent across age strata (data not shown), almost 50% of black patients were under age 50. Regardless of stage and consistent with other studies [6, 14, 54], we also found that breast cancer in black women, particularly those under age 50, was more prone to unfavorable prognostic factors that bode a more aggressive disease. This combination of more aggressive tumors with less timely treatment could seriously impact outcome. Overall delay is associated with lower survival [55]. However, the influence of treatment delays are less certain as most studies fail to distinguish diagnosis delay from treatment delay [30, 55–57]. Results from the National Breast and Cervical Cancer Early Detection Program reported treatment delays of two weeks or less [29]. In our study, only 50% of white women and 38% of black women received treatment within a two week interval. Time to diagnosis overall, and between races, was less efficient in our study and reasons for this merit further research.

Surgery

A disproportionate number of black women did not receive cancer directed surgery for local-regional disease, 7.5% vs. 1.5% of white women. Of these, 56% of black women and 27% of white women did receive chemotherapy. Tumor response to the chemotherapy may have inadvertently led patients to forgo surgery, but reasons for surgery not being performed need investigation. Although surgery is not recommended for metastatic disease, about 40% of women with distant metastatic disease received surgery. It is appropriate to surgically treat patients in these circumstances for local control, quality of life, and palliative

Table 2 First course treatment for invasive breast cancer (by race, within stage), Atlanta, GA, 2000–2001

	Local				Regional				Distant			
	Black		White		Black		White		Black		White	
	N	%	N	%	N	%	N	%	N	%	N	%
	427	21.4	1571	78.6	351	32.3	735	67.7	74	45.1	90	54.9
*Treatment delay**												
Same day	108	25.3	422	27.1	85	25.2	168	22.9	14	21.9	16	21.1
1–14 days	53	12.7	342	22.0	51	15.1	199	27.1	18	28.1	25	32.9
15–30 days	124	29.8	520	33.4	105	31.2	239	32.6	9	14.1	22	29.0
31–60 days	93	22.4	239	15.4	57	16.9	106	4.4	10	15.6	10	13.2
> 60 days	38	9.1	32	2.1	39	11.6	22	3.0	13	20.3	3	4.0
	P-Value*			<0.0001				0.0005				0.0781
*Type of 1st treatment**												
Surgery	391	94.0	1521	97.8	272	80.7	660	90.0	25	39.7	28	36.8
Chemotherapy[a]	23	5.5	25	1.6	64	19.0	70	9.6	31	49.2	21	27.6
Hormonal	1	0.2	1	0.1	0	0.0	1	0.1	2	7.9	9	23.7
Radiation	1	0.2	9	0.6	1	0.3	2	0.3	5	3.2	18	11.8
	P-Value*		.	<0.0001				<0.0001				0.2789
Surgery												
No	24	5.6	24	1.5	30	8.6	10	1.4	46	62.2	54	60.0
Yes	403	94.4	1547	98.5	321	91.5	725	98.6	28	37.8	36	40.0
	P-Value			<0.0001				<0.0001				0.8724
Type of surgery												
BCS[b]	263	65.3	999	64.6	129	40.2	307	42.4	12	42.8	17	47.2
Mastectomy	140	34.7	547	35.4	192	59.8	417	57.6	16	57.1	19	52.8
	P-Value*			0.8606				0.5406				0.8030
Nodal scope of surgery												
None	72	16.9	189	12.0	30	8.6	12	1.6	51	68.9	61	67.8
SLN	46	10.8	278	17.7	14	4.0	55	7.5	1	1.4	1	1.2
Other[c]	307	71.9	1097	69.8	306	87.2	666	90.6	21	28.4	24	26.7
Unknown	2	0.5	7	0.5	1	0.3	2	0.3	1	1.4	4	4.4
	P-Value*			0.0030				<0.0001				0.9850
Number nodes examined												
0	72	16.9	189	12.0	30	8.6	12	1.6	51	68.9	61	67.8
1–3	56	13.1	292	18.6	14	4.0	46	6.3	6	8.1	6	6.7
4–10	104	24.4	445	28.3	83	23.7	204	27.8	5	6.8	6	6.7
> 10	190	44.5	623	39.7	216	61.5	467	63.5	9	12.2	12	13.3
Examined, # unknown	3	0.7	15	1.0	5	1.4	3	0.4	2	2.7	1	1.1
Unknown	2	0.5	7	0.5	3	0.9	3	0.4	1	1.4	4	4.4
	P-Value*			0.0072				< 0.0001				0.8486
*Number nodes examined**												
1–3	56	15.9	292	21.2	14	4.4	46	6.4	6	27.3	6	24.0
4–10	104	29.5	445	32.4	83	26.1	204	28.3	5	22.7	6	24.0
> 10	190	53.8	623	45.3	216	67.9	467	64.9	9	40.9	12	48.0
Examined, # unknown	3	0.9	15	1.1	5	1.6	3	0.4	2	9.1	1	4.0
	P-Value*			0.0261				0.1097				0.8816

[a] Includes patients who received neoadjuvant treatment

[b] BCS (Breast conserving surgery) includes any procedure other than a simple, modified radical, or radical mastectomy or mastectomy NOS

[c] Includes surgical removal, biopsy, or aspiration

*Excludes unknowns, not examined or unknown if examined

Table 3 Racial differences in recipt of surgery, statified on tumor size and age[a]

	Black		White		Black		White		Black		White		Black		White	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Tumor size																
	≤ 1.0 cm				1.1–2.0 cm				2.1–5.0 cm				> 5.0 cm			
Surgery																
No	0	0	2	0.3	8	3.2	6	0.6	17	7.3	9	1.7	8	11.6	4	5.3
Yes	134	100.0	616	99.7	243	96.8	912	99.4	261	92.7	530	98.3	61	88.4	72	94.7
P-value				1.000				0.0036				< 0.0001				0.3131
Type of surgery[b, c]																
BCS[c]	90	67.2	425	69.0	168	69.1	586	64.3	92	43.4	217	42.1	10	18.2	10	16.1
Mastectomy	44	32.8	191	31.0	75	30.9	326	35.8	120	56.6	298	57.9	45	81.8	2	83.9
P-value				0.682				0.1723				0.8045				0.8095
Age at diagnosis																
	All ages				18–50				51–70				> 70			
Surgery																
No	30	4.5	20	0.9	16	5.1	3	0.5	7	2.6	6	0.6	7	7.3	11	2.2
Yes	644	95.5	2105	99.1	297	94.9	590	99.5	258	97.4	1021	99.3	89	92.7	497	97.8
P-value				< 0.0001				< 0.0001				0.0079				0.0146
Type of Surgery[b, c]																
BCS[c]	360	55.9	1238	58.8	167	56.2	319	54.1	153	59.3	656	64.2	40	44.9	266	53.5
Mastectomy	284	44.1	867	41.2	130	43.8	271	45.9	105	40.7	365	35.9	49	55.1	231	46.5
P-value				0.2012				0.5677				0.1697				0.1665

[a] Restricted to Local/Regional disease (Excludes diffuse, inflammatory, T4, microcalcifications)

[b] Restricted to women who received a surgical procedure

[c] BCS (Breast conserving surgery) includes any procedure other than a simple, modified radical, or radical mastectomy or mastectomy NOS

Table 4 Racial differences in receipt of radiation therapy by type of surgery, stratified on tumor size, nodal status, and age[a]

	Black		White		Black		White		Black		White		Black		White	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Age at diagnosis																
	All ages				18–50				51–70				> 70			
BCS + Radiation[b]																
No	138	38.4	349	28.2	64	38.3	89	27.9	59	38.6	162	24.8	15	37.5	98	36.8
Yes	222	61.7	889	71.8	103	61.7	230	72.1	94	61.4	491	75.2	25	62.5	168	63.2
	P-value			< 0.0001				0.0235				< 0.0001				1.000
Mastectomy + Radiation[c]																
No	31	68.9	29	55.8	16	61.6	11	50.0	10	71.4	9	56.3	5	100.0	9	64.3
Yes	14	31.1	23	44.2	10	38.4	11	50.0	4	28.6	7	43.8	0	0.0	5	35.7
	P-value			0.2129				0.5608				0.4664				0.257
Mastectomy + Radiation[d]																
No	14	46.7	23	42.6	6	46.2	11	50.0	8	50.0	10	35.7	0	0.0	2	50.0
Yes	16	53.3	31	57.4	7	53.9	11	50.0	8	50.0	18	64.3	1	100.0	2	50.0
	P-value			0.8196				1.000				0.5248				1.000
Tumor size																
	≤ 1.0 cm				1.1–2.0 cm				2.1–5.0 cm				> 5.0 cm			
BCS + Radiation[c]																
No	35	38.9	112	26.4	57	33.9	146	24.9	39	42.4	87	40.1	7	70.0	4	40.0
Yes	55	61.1	313	73.7	111	66.1	440	75.1	53	57.6	130	59.9	3	30.0	6	60.0
	P-value			0.0206				0.0233				0.7063				0.3698
Mastectomy + Radiation[d]																
No													31	68.9	29	55.8
Yes													14	31.1	23	44.2
	P-value															0.0213
Axillary lymph node status[e]																
	Node negative				1–3 Positve				≥ 4 Positive							
BCS + Radiation[c]																
No	65	30.7	172	20.9	38	46.3	76	32.2	14	46.7	23	42.6				
Yes	147	69.3	650	79.1	44	53.7	160	67.8	16	53.3	31	57.4				
	P-value			0.0033				0.0236				0.3848				
Mastectomy + Radiation																
No	99	85.3	442	93.3	50	71.4	184	81.8	50	64.9	56	44.4				
Yes	17	14.7	32	6.8	20	28.6	41	18.2	27	35.1	70	55.5				
	P-value			0.0085				0.0656				0.0120				

[a] Restricted to Local/Regional disease (Excludes diffuse, inflammatory, T4, microcalcifications)

[b] Restricted to patients who received BCS (Overall, 61% of black women and 72% of white women received radiation after BCS ($P < 0.0001$))

[c] Restricted to patients who received Mastectomy and had tumors larger than 5 cm

[d] Restricted to patients who received mastectomy and 4 or more axillary lymph nodes were positive

[e] For Local/Regional disease, breast radiotherapy should be given after BCS, regardless of nodal status; or after mastectomy if the tumor is greater 5 cm or 4 or more axillary nodes are positive

reasons. We do not know if this was the case. BCS is the preferred surgical choice for local-regional disease and smaller tumors [23, 48], and we found that black and white women received BCS equivalently. Similar to our findings, others have reported a lack of cancer-directed surgery among black women, but results regarding BCS have been conflicting [20, 27, 58, 59]. Surgery may be contraindicated for some women; however our findings do suggest surgical under-treatment for black women with local-regional disease, over-treatment of all women with metastatic disease, and that breast conservation for all women merits improvement.

Table 5 Racial differences in receipt of chemotherapy for invasive breast cancer, stratified on tumor characteristics, nodal status, and age[a, b]

	Black		White		Black		White		Black		White		Black		White	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
	Node negative				Node positive											
No	289	65.4	1154	73.4	88	27.1	204	29.2								
Yes	153	34.6	412	26.3	234	72.9	495	70.8								
	P-value			< 0.0001				0.9871								
Tumor size																
	≤ 1.0 cm				1.1–2.0 cm				2.1–5.0 cm				> 5.0 cm			
No	134	78.8	590	84.3	124	49.2	513	55.6	86	36.9	229	42.3	18	26.1	27	35.5
Yes	36	21.2	110	15.7	128	50.8	409	44.4	147	63.1	312	57.7	51	73.9	49	64.5
	P-value			0.1085				0.0746				0.1753				0.2811
Patients with node negative disease—by tumor size																
	≤ 1.0,cm				1.1–2.0 cm				2.1–5.0 cm				> 5.0 cm			
No	119	90.8	547	91.3	98	58.7	427	65.6	49	48.0	138	54.1	7	35.0	16	57.1
Yes	12	9.2	52	8.7	69	41.3	224	34.4	53	52.0	117	45.9	13	65.0	12	42.9
	P-value	0.8648		0.1038		0.3482		0.1542								
	Tumors ≤ 1.0 cm								Tumors ≤ 2.0 cm							
	Grade I				Grade 2 or 3				Grade I				Grade 2 or 3			
No	27	96.4	195	97.0	74	87.1	303	87.8	48	88.9	292	88.8	143	66.8	603	73.1
Yes	1	3.6	6	3.0	11	12.9	42	12.2	6	11.1	37	11.3	71	33.2	222	26.9
	P-value	1.000		0.8544		1.000		0.0737								
	Tumors ≤ 1.0 cm								Tumors ≤ 2.0 cm							
	ER–PR–[c]				ER+, PR+, or Both[d]				ER–PR–[c]				ER+, PR+, or Both[d]			
No	16	76.2	46	78.0	104	93.7	503	92.8	40	50.6	78	51.3	179	81.0	903	81.7
Yes	5	23.8	13	22.0	7	6.3	39	7.2	39	49.4	74	48.7	42	19.0	203	18.3
		1.000		0.8411		1.000		0.8495								
By age groups																
	All ages				18–50				51–70				> 70			
Patients with node positive disease																
No	88	27.3	204	29.2	31	17.7	45	17.0	36	32.4	82	24.1	21	58.3	77	72.0
Yes	234	72.7	495	70.8	144	82.3	207	82.1	75	67.6	258	75.9	15	41.7	30	28.0
	P-value			0.5521				1.000				0.054				0.1486
Patients with node negative disease																
(Tumors larger than 1.0 cm)																
No	154	53.3	581	62.2	47	36.7	81	32.1	74	62.2	254	60.1	33	78.6	246	95.0
Yes	135	46.7	353	37.8	81	63.3	171	67.8	45	37.8	169	40.0	9	21.4	13	5.0
	P-value			0.0074				0.4216				0.7503				0.0011
(Tumors larger than 2.0 cm)																
No	56	45.9	154	54.4	15	26.8	20	26.3	24	53.3	47	40.9	17	80.9	87	94.6
Yes	66	54.1	129	45.6	41	73.2	56	73.7	21	46.7	68	59.1	4	19.1	5	5.4
	P-value			0.1295				1.000				0.1619				0.0011
(Tumors smaller than 1.0 cm and Grade > I)																
No	74	87.1	302	87.8	24	82.8	62	74.7	34	85.0	149	88.7	16	100.0	91	97.9
Yes	11	12.9	42	12.2	5	17.2	21	25.3	6	15.0	19	11.3	0	0.0	2	2.2
	P-value			0.8546				0.4516				0.5880				1.000
(Tumors smaller than 2.0 cm and Grade > I)																
No	142	66.7	597	73.0	46	53.5	110	48.5	68	70.8	295	75.5	28	90.3	192	96.0
Yes	71	33.3	221	27.0	40	46.5	117	51.5	28	29.2	96	24.6	3	9.7	8	4.0
	P-value			0.0732				0.4494				0.3616				0.1707

Table 5 continued

	Black		White		Black		White		Black		White		Black		White	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
(Tumors smaller than 1.0 cm and ER–PR–)[c]																
No	16	76.2	46	78.0	5	62.5	14	70.0	8	80.0	22	78.6	3	100.0	10	90.9
Yes	5	23.8	13	22.0	3	37.5	6	30.0	2	20.0	6	21.4	0	0.0	1	9.1
	P-value			1.000				1.000				1.000				1.000
(Tumors smaller than 2.0 cm and ER+, PR+, or both ER+PR+)[d]																
No	140	78.7	736	80.7	38	63.3	117	54.7	73	84.8	387	83.8	29	90.6	232	98.3
Yes	38	21.4	176	19.3	22	36.7	97	45.3	13	15.1	75	16.2	3	9.4	4	1.7
	P-value			0.5365				0.2456				0.8740				0.0389

[a] Restricted to Local/Regional disease (Excludes diffuse, inflammatory, T4, microcalcifications)

[b] Chemotherapy should be given to most patients with lymph node metastasis or with tumors larger than 1 cm, regardless of nodal status

For patients older than 70, there is limited data to determine efficacy of chemotherapy. Chemotherapy may be considered for women with ≤ 1.0 cm tumors and node negative disease who are > grade 1 or ER/PR negative [23, 24]

Chemotherapy may be considered for women with ≤ 2.0 cm tumors and node negative disease who are > grade 1 or ER/PR negative (St. Gallen)

Chemotherapy should not be given to women with ≤ 2.0 cm tumors, node negative disease, who are ER+, PR+, or both (St. Gallen)

[c] ER–PR– = Estrogen Receptor negative and Progesterone Receptor negative

[d] ER+ = Estrogen Receptor Positive; PR+ = Progesterone Receptor Positive

Radiation

For local-regional disease, radiation therapy should be given after BCS, regardless of nodal status [23, 48]. Only 60–70% of our study patients received radiotherapy after BCS. Compared to white women, black women were consistently and significantly less likely to receive radiotherapy after BCS; including those with smaller tumors, node negative disease, < 4 positive regional nodes, or under age 70 years. Radiation should also be given after mastectomy if the tumor is greater than 5.0 cm or 4 or more nodes are positive [23, 24]. Black women, again, were less likely to receive radiation for either of these scenarios, although the difference for the former was not significant. Other population-based studies have indicated that black women are at significant risk of not receiving radiotherapy as recommended [15, 27, 33] and reasons for this may be related to extraneous factors such as transportation and social support.

Chemotherapy

In general, women were under-treated with adjuvant chemotherapy. Although black women were somewhat more likely to receive chemotherapy, the racial differences were not significant, regardless of nodal status, tumor size, or age. Of note, the proportion of women with combined small tumors and aggressive traits (higher grade, or ER–PR–) who should have received chemotherapy was very low (12–24%). We also investigated type of chemotherapy received (data not shown). Multiple agents are preferred over single agents and a vast majority of both black and white women received multiple agents (96.5% and 96.0% respectively).

Hormonal therapy

The benefits of hormonal therapy are clear. Adjuvant hormonal therapy should be recommended to all women with ER or PR positive tumors, regardless of age, menopausal status, tumor size, nodal status, or Her2/neu status [23, 24, 48]. Only a minority of women in our study who could have received hormonal therapy were documented as having done so; 41% of the women who were ER and/or PR positive. Receipt of hormonal therapy among black women was considerably less than for white women and did not appreciably vary whether we investigated ER+ and/or PR+, ER+, PR+, or ER+PR+ tumor status, or age groups. Consistent with other population-based findings [45], the prevalence of ER or PR positive tumors was significantly less for black women compared to white women. Thus, due to tumor status, and exacerbated by treatment differences, black women in our study were at a severe disadvantage in reaping the benefits of hormone therapy.

While the effects of racial differences in breast cancer treatments are uncertain [5, 10, 14, 20–22, 33], treatment recommendations are based on high level evidence that demonstrate their efficacy for improving outcomes. The Institute of Medicine recently published a document outlining quality measures for improving standards of breast cancer diagnosis and treatment in Georgia, based on

Table 6 Racial differences in receipt of hormonal therapy for invasive breast cancer, stratified on hormone receptor status and age[a]

	All ages				18–50				51–70				> 70			
	Black		White		Black		White		Black		White		Black		White	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
	877	26.5	2437	73.5	397	37.4	665	62.6	346	22.8	1171	77.2	134	18.2	601	81.8
Hormonal therapy																
Overall																
No	730	83.2	1571	64.5	337	84.9	440	66.2	286	82.7	731	62.4	107	79.9	400	66.6
Yes	147	16.8	866	35.5	60	15.1	225	33.8	60	17.3	440	37.6	27	20.2	201	33.4
P-value				< 0.0001				< 0.0001				< 0.0001				< 0.0001
ER+, PR+, or Both																
No	326	73.1	915	54.7	139	73.9	240	54.7	136	73.9	433	52.7	51	68.9	242	58.6
Yes	120	26.9	758	45.3	49	26.1	199	45.3	48	26.1	388	47.3	23	31.1	171	41.4
P-value				< 0.0001				< 0.0001				< 0.0001				0.1214
Unknown ER and PR																
No	141	89.2	322	79.2	61	89.7	65	76.5	51	87.9	152	78.8	29	90.6	105	81.4
Yes	17	10.8	85	20.9	7	10.3	20	23.5	7	10.1	41	21.2	3	9.4	24	18.6
P-value				0.0049				0.0352				0.1318				0.2930
ER–PR–[b]																
No	263	96.3	334	93.6	137	97.2	135	95.7	99	95.2	146	93.0	27	96.4	53	89.8
Yes	10	3.7	23	6.4	4	2.8	6	4.3	5	4.8	11	7.0	1	3.6	6	10.2
P-value				0.1491				0.7494				0.6014				0.4210
ER+PR+[c]																
No	255	71.2	711	52.5	106	72.1	191	51.6	108	73.5	330	50.6	41	64.1	190	57.2
Yes	103	28.8	643	47.5	41	27.9	179	48.4	39	26.5	322	49.4	23	35.9	142	42.8
P-value				< 0.0001				< 0.0001				< 0.0001				0.3350

[a] Hormonal therapy should be recommended to all women with ER+ or PR+ tumors, regardless of age, menopausal status, tumor size, axillary lymph node or HER-2neu status. If the tissue sample is insufficient for analyses, receptor status should be considered positive [24]

[b] ER–PR– = Both Estrogen Receptor negative and Progesterone Receptor negative

[c] ER+PR+ = Both Estrogen Receptor positive and Progesterone Receptor positive

established treatment guidelines [60]. Our findings from Atlanta SEER data, suggest these standards are not adequately implemented even in a large metropolitan area where teaching hospitals provide a sizeable proportion of breast cancer care. With respect to adjuvant therapies, a preponderance of women was under-treated. A SEER national study reported a decrease in appropriate use of adjuvant therapies from 1983–1995 [61] and a more recent SEER national study found that trends in the appropriate use of adjuvant hormonal therapy and chemotherapy have increased over time from 1987–2000, but 10–25% of the patients received neither treatment and the results were not reported within racial/ethnic groups [62]. The lack of quality care among black women in our study is of particular concern. Treatment differences can adversely affect outcome and reasons for the differences need to be explored. Efforts to reduce suboptimal treatment could improve outcomes for all women, and could significantly contribute to eliminating the poorer outcomes experienced by black women. The power of provision of high quality care is illustrated in the population-based study of Wojcik and colleagues [17]. In this US Department of Defense equal access system, black women diagnosed with breast cancer had a five-year mortality rate of 24.8% compared with 18.1% for whites. Equivalent rates in the US at that time were 34.2 and 18.2%. Their study suggests that improved access and utilization of prevention and treatment services can reduce survival disparity by as much as two-thirds.

Limitations

The under-treatment we report for adjuvant therapies may be inflated. The medical record is not as complete for adjuvant treatments and under-reporting may be considerably high in the SEER registry, especially for chemotherapy and hormonal therapy. This is partially attributable to adjuvant therapies being given outside of the diagnostic

and treatment facilities from which the SEER data is abstracted, and potentially months after initial diagnosis. Notwithstanding, these differences should not affect women differentially, thus the observed racial differences need further investigation. In a sub-sample of patients whose data were re-abstracted as part of a patterns of care study, we observed that a higher proportion of patients were found to receive hormonal therapy, yet the racial differences persisted. Information on HER-2/neu status is not available from the SEER registry, thus we could not examine the equivalency of HER-2/neu testing among women or appropriate receipt of systemic therapy. We also did not have information on health status and comorbidities which could have contraindicated receipt of some treatments. However, the data indicate that contraindications were not a major contributing factor.

Strengths

This is one of the first studies to report on racial differences in a comprehensive array of first course treatments, utilizing specific treatment guidelines as the standard for comparing differences. This study may be the first in a targeted population-based setting where outcomes are more readily translational to the community. In the national SEER data, black women comprise only 7–8% of the female breast cancer population. Our study represented a large proportion of black women, women for whom there has been a paucity of representation or treatment studies.

Conclusion

Our findings suggest treatment standards are not adequately or equivalently met among Black and White women, even in an area where teaching hospitals provide a substantial portion of breast cancer care. A considerable proportion of women received sub-optimal first course treatment for invasive breast cancer. Black women were more likely to not receive recommended surgical, radiation, or hormonal treatments and to experience delays in treatment. Treatment differences can adversely affect outcome and reasons for the differences need to be addressed. Efforts to translate these findings into improved treatment adherence could enhance outcomes for all women, particularly those most disadvantaged.

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References

1. Anonymous (2006) Cancer Facts and Figures 2006. American Cancer Society, Atlanta, GA
2. Ries LAG, Eisner MP, Kosary CL et al (2004) SEER Cancer Statistics Review, 1975–2002. National Cancer Institute, Bethesda, MD
3. Clegg LX, Li FP, Hankey BF et al (2002) Cancer survival among US whites and minorities: a SEER (Surveillance, Epidemiology, and End Results) Program population-based study. Arch Intern Med 162(17):1985–1993
4. Joslyn SA, West MM (2000) Racial differences in breast carcinoma survival. Cancer 88(1):114–123
5. Chu KC, Lamar CA, Freeman HP (2003) Racial disparities in breast carcinoma survival rates, Separating factors that affect diagnosis from factors that affect treatment. Cancer 97(11):2853–2860
6. Swanson GM, Hazlam SZ, Azzouz F (2003) Breast cancer among young African-American women. Summit Meeting on Breast Cancer. Cancer 97 (1 Suppl):273–279
7. Li CI, Malone KE, Daling JRM (2002) Differences in breast cancer hormone receptor status and histology by race and ethnicity among women 50 years of age and older. Cancer Epidemiol Biomarkers Prev 11(7):601–607
8. Bach PB, Schrag D, Brawley OW et al (2002) Survival of blacks and whites after a cancer diagnosis. JAMA 287(16):2106–2113
9. Hunter CP, Redmond CK, Chen VW, et al (1993) Breast cancer: factors associated with stage at diagnosis in black and white women. Black/White Cancer Survival Study Group. J Natl Cancer Inst 85(14):1129–1137
10. Eley JW, Hill HA, Chen VW et al (1994) Racial differences in survival from breast cancer. Results of the National Cancer Institute Black/White Cancer Survival Study. JAMA 272(12): 947–954
11. West DW, Satariano WA, Ragland DR et al (1996) Comorbidity and breast cancer survival: a comparison between black and white women. Ann Epidemiol 6(5):413–419
12. Yood MU, Johnson CC, Blount A et al (1999) Race and differences in breast cancer survival in a managed care population. J Natl Cancer Inst 91(17):1487–1491
13. Jatoi I, Becher H, Leake CR (2003) Widening disparity in survival between white and African-American patients with breast carcinoma treated in the U.S. Department of Defense Healthcare system. Cancer 98(5):894–899
14. Dignam JJ (2000) Differences in breast cancer prognosis among African-American and Caucasian women. CA Cancer J Clin 50(1):50–64
15. Roetzheim RG, Gonzalez EC, Ferrante JM et al (2000) Effects of health insurance and race on breast carcinoma treatments and outcomes. Cancer 89(11):2202–2213
16. Brawley OW (2002) Disaggregating the effects of race and poverty on breast cancer outcomes [comment]. J Natl Cancer Inst 94(7):471–473
17. Wojcik BE, Spinks MK, Optenberg SA (1998) Breast carcinoma survival analysis for African American and white women in an equal-access health care system. Cancer 82(7):1310–1318
18. Chlebowski RT, Chen Z, Anderson GL et al (2005) Ethnicity and breast cancer: factors influencing differences in incidence and outcome. J Natl Cancer Inst 97(6):439–448
19. Newman LA, Mason J, Cote D et al (2002) African-American ethnicity, socioeconomic status, and breast cancer survival. Cancer 94(11):2844–2854
20. Li CI, Malone KE, Daling JR (2003) Differences in breast cancer stage, treatment, and survival by race and ethnicity. Arch Intern Med 163(1):49–56

21. McWhorter WP, Mayer WJ (1987) Black/white differences in type of initial breast cancer treatment and implications for survival. Am J Public Health 77(12):1515–1517
22. Newman LA, Theriault R, Clendinnin N et al (2003) Treatment choices and response rates in African-American women with breast carcinoma. Cancer 97(1 Suppl):246–252
23. National Comprehensive Cancer Network (NCCN) Clinical Practice Guidelines in Oncology - V.1; 2000
24. NIH Consensus Statement—Adjuvant Therapy for Breast Cancer (2000) 17(4):1–42
25. Bast RC Jr, Ravdin P, Hayes DF et al (2001) 2000 update of recommendations for the use of tumor markers in breast and colorectal cancer: clinical practice guidelines of the American Society of Clinical Oncology. J Clin Oncol 19(6):1865–1878
26. Breen N, Wesley MN, Merrill RM et al (1999) The relationship of socio-economic status and access to minimum expected therapy among female breast cancer patients in the National Cancer Institute Black-White Cancer Survival Study. Ethn Dis 9(1):111–125
27. Ayanian JZ, Guadagnoli E (1996) Variations in breast cancer treatment by patient and provider characteristics. Breast Cancer Res Treat 40(1):65–74
28. White J, Morrow M, Moughan J et al (2003) Compliance with breast-conservation standards for patients with early-stage breast carcinoma. Cancer 97(4):893–904
29. Caplan LS, May DS, Richardson LC (2000) Time to diagnosis and treatment of breast cancer: results from the National Breast and Cervical Cancer Early Detection Program, 1991–1995. Am J Public Health 90(1):130–134
30. Dennis CR, Gardner B, Lim B (1975)Analysis of survival and recurrence vs. patient and doctor delay in treatment of breast cancer. Cancer 35(3):714–720
31. Gwyn K, Bondy ML, Cohen DS et al (2004) Racial differences in diagnosis, treatment, and clinical delays in a population-based study of patients with newly diagnosed breast carcinoma. Cancer 100(8):1595–1604
32. Ramirez AJ, Westcombe AM, Burgess CC et al (1999) Factors predicting delayed presentation of symptomatic breast cancer: a systematic review. Lancet 353(9159):1127–1131
33. Joslyn SA (2002) Racial differences in treatment and survival from early-stage breast carcinoma. Cancer 95(8):1759–1766
34. Shavers VL, Harlan LC, Stevens JL (2003) Racial/ethnic variation in clinical presentation, treatment, and survival among breast cancer patients under age 35. Cancer 97(1):134–147
35. Mincey BA, Palmieri FM, Perez EA (2002) Adjuvant therapy for breast cancer: recommendations for management based on consensus review and recent clinical trials. Oncologist 7(3):246–250
36. Aapro MS (2001) Adjuvant therapy of primary breast cancer: a review of key findings from the 7th international conference, St. Gallen, February 2001. Oncologist 6(4):376–385
37. Ownby HE, Frederick J, Russo J et al (1985) Racial differences in breast cancer patients. J Natl Cancer Inst 75(1):55–60
38. Griggs JJ, Sorbero ME, Stark AT et al (2003) Racial disparity in the dose and dose intensity of breast cancer adjuvant chemotherapy. Breast Cancer Res Treat 81(1):21–31
39. Muss HB, Hunter CP, Wesley M et al (1992) Treatment plans for black and white women with stage II node-positive breast cancer. The National Cancer Institute Black/White Cancer Survival Study experience. Cancer 70(10):2460–2467
40. Elledge RM, Clark GM, Chamness GC et al (1994) Tumor biologic factors and breast cancer prognosis among white, Hispanic, and black women in the United States.[comment]. J Natl Cancer Inst 86(9):705–712
41. Diehr P, Yergan J, Chu J et al (1989) Treatment modality and quality differences for black and white breast-cancer patients treated in community hospitals. Med Care 27(10):942–958
42. Bickell NA, Wang JJ, Oluwole S et al (2006) Missed opportunities: racial disparities in adjuvant breast cancer treatment. J Clin Oncol 24(9):1357–1362
43. English WP, Cleveland KE, Barber WH (2002) There is no difference in survival between African-American and white women with breast cancer. Am Surg 68(6):594–597
44. Gapstur SM, Dupuis J, Gann P et al (1996) Hormone receptor status of breast tumors in black, Hispanic, and non-Hispanic white women. An analysis of 13,239 cases. Cancer 77(8):1465–1471
45. Chu KC, Anderson WF, Fritz A et al (2001) Frequency distributions of breast cancer characteristics classified by estrogen receptor and progesterone receptor status for eight racial/ethnic groups. Cancer 92(1):37–45
46. Anderson WF, Chatterjee N, Ershler WB et al (2002) Estrogen receptor breast cancer phenotypes in the Surveillance, Epidemiology, and End Results database. Breast Cancer Res Treat 76(1):27–36
47. ICD-O (2000) International Classification of Diseases for Oncology, 3rd edn. World Health Organization, Geneva
48. Goldhirsch A, Glick JH, Gelber RD et al (1998) International Consensus Panel on the treatment of primary breast cancer. J Natl Cancer Inst 90:1601–1608
49. Anonymous (2001) NIH consensus panel recommends a range of adjuvant therapies for women with breast cancer. J Am Coll Surg 192(2):288
50. Young JL, Roffers SD, Ries LAG, et al (eds) (2001) SEER Summary Staging Manual—2000: codes and coding instructions. National Cancer Institute, Bethesda, MD
51. Fritz A, Ries LAG (eds) (1998) SEER extent of disease, codes and coding instructions, 3rd edn. National Cancer Institute, Bethesda, MD
52. Fleming ID, Cooper JS, Henson DE et al (1997) AJCC Cancer Staging Manual, 5th edn. Chicago, IL
53. Fitzgibbons PL, Page DL, Weaver D et al (2000) Prognostic factors in breast cancer. College of American Pathologists Consensus Statement 1999. Arch Pathol Lab Med 124(7):966–978
54. Porter PL, Lund MJ, Lin MG et al (2004) Racial differences in the expression of cell cycle-regulatory proteins in breast carcinoma. Cancer 100(12):2533–2542
55. Richards MA, Westcombe AM, Love SB et al (1999) Influence of delay on survival in patients with breast cancer: a systematic review [see comment]. Lancet 353(9159):1119–1126
56. Richards MA, Smith P, Ramirez AJ et al (1999) The influence on survival of delay in the presentation and treatment of symptomatic breast cancer. Br J Cancer 79(5–6):858–864
57. Gregorio DI, Cummings KM, Michalek A (1983) Delay, stage of disease, and survival among White and Black women with breast cancer. Am J Public Health 73(5):590–593
58. Bradley CJ, Given CW, Roberts C (2002) Race, socioeconomic status, and breast cancer treatment and survival. J Natl Cancer Inst 94(7):490–496
59. Shavers VL, Brown ML (2002) Racial and ethnic disparities in the receipt of cancer treatment. J Natl Cancer Inst 94(5):334–357
60. Hewitt M, Simone J (eds) (2005) Assessing the quality of cancer care: An approach to measurement in Georgia. Institute of Medicine, The National Academies Press, Washington, DC
61. Nattinger AB, Hoffmann RG, Kneusel RT et al (2000) Relation between appropriateness of primary therapy for early-stage breast carcinoma and increased use of breast-conserving surgery. Lancet 356(9236):1148–1153
62. Harlan LC, Clegg LX, Abrams J et al (2006) Community-based use of chemotherapy and hormonal therapy for early-stage breast cancer: 1987–2000. J Clin Oncol 24(6):872–877