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Socioeconomic and Racial Differences in Treatment for Breast Cancer at a Low-Volume Hospital

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Abstract

Purpose—Population-based studies have revealed higher mortality among breast cancer patients treated in low-volume hospitals. Other studies have demonstrated disparities in race and socioeconomic status (SES) in breast cancer survival. The purpose of our study was to determine whether nonwhite or low-SES patients are disproportionately treated in low-volume hospitals.

Methods—A population-based cohort of 2,777 Medicare breast cancer patients who underwent breast cancer surgery in 2003 participated in a survey study examining breast cancer outcomes. Information was obtained from survey responses, Medicare claims, and state tumor registry data.

Results—On univariate analysis, patients treated at low-volume hospitals were less likely to be white, less likely to live in an urban location, and more likely to have a low SES with less social support and live a greater distance from a high-volume hospital. Education, marital status, total household income, having additional insurance besides Medicare, population density of primary residence, and tangible support were associated with distance to the nearest high-volume hospital. On multivariate analysis, the independent predictors of treatment at a low-volume hospital were being nonwhite ($P = 0.003$), having a lower household income ($P < 0.0001$), residence in a rural location ($P = 0.01$), and living a greater distance from a high-volume hospital ($P < 0.0001$).

Conclusions—In this large population-based cohort, women who were poorer, nonwhite, and who lived in a rural location or at a greater distance from a high-volume hospital were more likely to be treated at low-volume hospitals. These differences may partially explain racial and SES disparities in breast cancer outcomes.

Studies have demonstrated disparities in survival in breast cancer, particularly with nonwhite and lower socioeconomic status (SES) patients exhibiting poorer outcomes.[1–8] Women of low SES have been found to have a risk of dying that is 30–50% higher than in women of higher SES.[9,10] Similarly, black women have been found to have a 37% higher mortality rate than white women.[7] Biologic factors have been sought to explain survival disparities by race/ethnicity but are not plausible explanations for SES disparities.[11] Clearly, biologic factors cannot explain all disparities. Determining the root cause of these disparities is essential to formulating public policy to address the problem.

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There is also a growing body of literature focusing on the relationship of hospital volume of cases to outcomes in breast cancer.[12–19] The majority of these studies have established a direct relationship between higher case volume and improved outcomes.[12,13,20–22] Gilligan et al. demonstrated that both overall mortality and breast cancer–specific mortality were higher in low-volume hospitals, with low-volume hospitals defined as 0–19 cases per year.[23] Other investigators have made similar findings.[15,21,24] However, there is a paucity of literature that establishes a relationship between hospital volume and the observed racial and SES disparities in breast cancer survival. Specifically, studies have not been conducted to determine whether disparities in SES and race/ethnicity could be attributable to disproportionate care in low-volume hospitals.

The purpose of this study was to determine whether low SES and nonwhite breast cancer patients disproportionately utilize low-volume hospitals by using a population-based cohort of Medicare patients. We also wished to explore the relationship of distance to nearest hospital and determine whether residence closer to a high-volume hospital affects low-SES patients or minorities differentially.

METHODS

Data Source

The data for this study were derived from a multimodal study of older breast cancer survivors residing in four diverse states: California, Florida, Illinois, and New York. The methods for recruiting and assessing the subjects have been reported previously.[25] Briefly, a Medicare- based prediction algorithm was used to identify women undergoing breast cancer surgery in 2003.[26] After establishing telephone contact, potential subjects were invited to participate in four surveys conducted at approximately annual intervals. Among those eligible, initial participation in the study was 70%, and participants were similar to nonparticipants with regard to race, SES, and hospital volume.[25] The data used in this study were derived from the baseline survey, conducted between October 2005 and October 2006.

Initial selection criteria included women aged 65–89 years who underwent surgery for incident breast cancer in 2003. Inclusion criteria required enrollment in Medicare Parts A and B and not in a Medicare health maintenance organization for calendar year 2003, to have had a breast cancer operation in 2003 according to the prediction algorithm, and to have an associated Medicare surgeon claim. Subjects were excluded if they had incorrect or incomplete contact information, were deceased by the time of contact, had a diagnosis of dementia or a long-term facility stay of 100 days or more in 2003, were physically unable to participate, were residing in a long-term care facility at the time of contact, did not speak English or Spanish, or did not confirm a diagnosis of incident breast cancer in 2003 once contacted. Among the 3083 subjects aged 65–89 in 2003 who completed the initial survey wave, subjects who were operated in a hospital with an unknown hospital volume ($n = 290$) or who had distant disease ($n = 16$) were excluded. Therefore, 2777 subjects were included in this study.

Subjects participating in the baseline survey also consented to the use of their Medicare claims and state tumor registry data routinely collected in all four states. We used the following Medicare files: (1) the Inpatient Standard Analytic Files (SAF), which contains claims for inpatient facilities; (2) the Outpatient SAF, which contains claims for outpatient facilities; (3) the 100% Carrier SAF, which contains claims for physician services; and (4) the denominator file, which contains information on beneficiary enrollment and zip code of residence. All four state tumor registries are members of the North American Association of Central Cancer Registries, which is a professional organization that develops and promotes uniform data standards for registries in Canada and the United States.[27]

Definition of Variables

Hospital Volume—Medicare claims were used to determine annual Medicare hospital volume of breast cancer cases. Hospital volume was defined as the annual volume in 2002–2003 of Medicare breast cancer operations for the hospital at which the patient underwent breast surgery.

Hospital volume was divided into tertiles that were based on our previous study.[23] The low-volume group (defined as hospitals performing fewer than 20 Medicare breast cancer operations a year) was compared to the higher-volume group (the remaining hospitals). A multivariate model was constructed to predict treatment in a low-volume hospital, which was the main focus from a quality-of-care and policy perspective.

Patient Characteristics—Patient age in 2003 was determined from Medicare claims. Race was determined primarily from survey data. Medicare claims were used if race was not reported in the survey data. Data extracted from Medicare claims also included whether the subject resided in a metropolitan area of at least 250,000 persons, and an index of comorbid illness based on the Klabunde method.[28]

Marital status, total annual household income, education, Medicaid coverage, other insurance coverage, emotional support scale, and tangible support scale were all obtained from the baseline survey. Measurement of social support used the Medical Outcomes Study Social Support Scale, a validated measure of patients' perceptions of help and support available to them in various aspects of life.[29,30] The study participants were asked 12 questions; eight were related to emotional/informational support (e.g., "someone to give you information to help you understand a situation," "someone to turn to for suggestions about how to deal with a personal problem), and four were related to tangible support around the time of breast cancer diagnosis and treatment (e.g., "someone to take you to the doctor if you needed it"). A 5-point Likert scale was used to answer each question, with 1 = none of the time and 5 = all of the time. Two subscale (emotional/informational and tangible) scores were then determined, and quartiles were formed.

Surveillance, Epidemiology, and End Results Program (SEER) stage was determined from tumor registry data. SEER stage was based on the SEER Summary Stage 2000, which used the following classification of patients: 0, in situ; 1, localized; 2, regional; direct extension; 3, regional; regional lymph nodes only; 4, regional; direct extension and regional lymph nodes; 5, regional, not otherwise specified (NOS); 6, missing; 7, distant.[31]

Street address information for patient residence and hospitals was converted to corresponding coordinate locations (i.e., geocoded) with ArcGIS (Esri, Redlands, CA). These point locations were used in conjunction with Network Analyst extension in ArcGIS to calculate driving distance from each patient residence to the nearest hospital and the nearest high-volume hospital, defined as a hospital performing 40 or more Medicare breast cancer operations annually.

The institutional review board of the Medical College of Wisconsin approved the study design.

Statistical Analysis

Descriptive statistics were performed by SAS software, version 9.1 (SAS Institute, Cary, NC). Hospital volume was divided into tertiles on the basis of a propensity analysis conducted on a previous study that examined hospital volume.[23] Univariate associations were evaluated by chi-square or Wilcoxon rank sum tests. Group comparisons of hospital distances were calculated by the Kruskal-Wallis test. Multivariate analysis was conducted

by a logistic regression model with the outcome of treatment in a low-volume hospital versus not. A statistical significance (alpha) level of 0.05 was used.

RESULTS

Of the 2777 breast cancer survivors in the study, 935 (33.7%) were treated at 381 low-volume hospitals and 1842 (66.3%) were treated at 188 higher-volume hospitals. The median age of the cohort was 72 years (range 65–89 years). Most subjects were white, and approximately half were married (Table 1). The large majority had completed high school, and about a quarter had completed college. More than half resided in an urban area, while only a small percentage lived in a rural area. Most subjects had supplemental insurance to Medicare, which was Medicaid for a small percentage. Just over half the patients had localized disease, and most had no comorbid illness.

Subjects treated at low-volume hospitals were generally less likely to be white and more likely to be of a lower SES (Table 1). They were less likely to be married, less likely to have completed more than a high school education, and more likely to have Medicaid as another source of insurance. Subjects treated in low-volume hospitals were less likely to live in an urban location and on average lived farther away from a high-volume hospital (≥40 cases per year). Such subjects were also slightly less likely to report a high degree of available emotional support. Patients treated at low-volume hospitals did not greatly differ from those treated at higher-volume hospitals with regard to age, tangible support, SEER stage, and distance from the nearest hospital, and comorbidities.

Table 2 shows the relationship of socioeconomic factors and distance to any hospital or high volume hospital. We chose to focus on distances to high volume hospitals (≥40 cases per year) because we have previously demonstrated a difference in mortality between this group and the low volume group.[23] When exploring SES indicators and hospital traveling distance, we observed sociodemographic differences in the distance traveled to the nearest high-volume hospital. Little variation was observed in distances to the nearest hospital among all groups. However, married women, those with less education, those with no other source of insurance, and those with lower available emotional support on average resided a longer traveling distance from a high-volume hospital. Women living in rural areas also lived much further from a high-volume hospital, as did women in the lower three income quartiles.

A multivariate analysis was conducted to determine factors independently associated with treatment at a low-volume hospital (Table 3). The factors independently associated with treatment at a low-volume hospital were race, population density, household income, and distance from the nearest high-volume hospital. Specifically, subjects who were treated at a low-volume hospital were more likely to be black or Hispanic and were more likely to live in a rural location. For each increase of $10,000 in total annual household income, women were 10% less likely to be treated at a low-volume hospital. The farther away patients lived from the nearest high-volume hospital, the less likely they were to utilize it. With each increase of 10 miles from the nearest high-volume hospital, subjects were 5% more likely to use a low-volume hospital, even when controlling for all other factors.

DISCUSSION

This population-based study of 2,777 Medicare breast cancer survivors who underwent breast cancer surgery in 2003 found both racial and SES predictors of treatment in a low-volume hospital. Those treated at low-volume hospitals were more likely to be black or Hispanic, to live in a rural setting, and to be of a lower SES. We also found that the greater distance they had to travel to a high-volume hospital, the less likely they were to seek care

from these hospitals. The distances traveled to high-volume hospitals (≥40 cases/year) were greater for women with a lower household income who lived in rural areas, who were less educated, who were married, and who had less emotional support. Nonetheless, racial and socioeconomic disparities in treatment at a low-volume hospital persisted even after controlling for distance from residence to the nearest high-volume hospital. Being black or Hispanic, living in a rural area, having a lower household income, and living a greater distance from the nearest high-volume hospital were all factors independently associated with treatment at a low-volume hospital.

Breast cancer is the cancer with the highest incidence among women in the United States.[32] We have shown previously that the vast majority of this care is decentralized, with only 10% of patients treated by surgeons who are performing at least 30 operations per year.[33] Recognizing this decentralization of care, interest has grown in the hospital volume–breast cancer outcome relationship. Prior studies have demonstrated improved survival with hospitals that treat higher volumes of breast cancer patients.[12,15,21,23] The nature of this relationship is complex and the specific mechanism is unclear.

Given these findings, treatment in low-volume hospitals would appear to be less desirable, particularly for those patients who are ethnic minorities or who are from a low SES—two groups that are particularly vulnerable to health care disparities. Low-volume hospitals have been shown to offer lower rates of radiation treatments and offer less definitive treatment.[13,14,24] These institutions may have less access to specialized providers, state-of-the-art treatments, or clinical trials, which may be related to a poor outcome. Their ability to provide multidisciplinary, coordinated care may also be limited, in addition to their ability to assess their own quality of care.

Beginning in 2009, the New York State Department of Health set forth a policy that mandated that Medicaid beneficiaries receive breast cancer surgery services at hospitals and ambulatory surgery centers that perform at least 30 of these procedures annually. Facilities that perform less than this threshold will not be reimbursed for these procedures provided to Medicaid patients. This policy is consistent with existing evidence supporting better breast cancer outcomes with higher case volumes.[34] Prior research that used New York State Cancer Registry data and the New York State hospital discharge database demonstrated that patients operated on at high-volume hospitals had far better 5-year survival, similar to our own work on a broader group of hospitals.[15] In France, a decree from the Ministry of Health and Solidarity in 2007 was issued that requires hospitals treating breast cancer to demonstrate that they perform ≥30 breast cancer surgeries a year.[35] However, it will be important to demonstrate whether these policy changes will actually affect breast cancer outcomes in their respective geographical areas.

These changes may not produce the desired effect if patients are unwilling to travel to high-volume centers. Reluctance to travel has been previously shown.[36,37] We found that poorer black and Hispanic patients from rural areas were more likely to go to low-volume hospitals. Centralizing high-quality care may further polarize existing disparities. Requiring patients to seek care from high-volume centers will increase travel distances, as we have shown here, and as others have also shown.[38] Also, patients may not obtain care as promptly if they are forced to travel longer distances. However, this policy change may be successful in places like New York and France, where an established infrastructure exists for public transportation.

There are several limitations to this study. First, this study focuses solely on Medicare patients and may not be generalizable to the younger breast cancer population. However, the fact that all patients were Medicare beneficiaries was a strength of the study in that it should

mitigate differences in insurance coverage and patient access to high-volume centers. We found that despite these factors, racial and socioeconomic factors persisted.

Another limitation is that we may have some inaccuracy in hospital distance measurements. For patients residing near a state border, the nearest hospital could be located in another state. We only measured distances to in-state facilities. However, Table 2 demonstrates that there is homogeneity in distances to nearest hospitals, and distances to the nearest high-volume hospitals are consistent with population density (that is, subjects who lived in rural areas lived a greater distance from a high-volume hospital).

Finally, although we found that minority and low-SES patients are more likely to be operated on at low-volume hospitals, we cannot conclude that this finding is the sole reason for survival disparities in breast cancer. This finding is likely one of several factors that govern survival. However, we can infer that this factor may well partially account for the survival disparities.

With this study, we have established that in this population-based cohort of Medicare breast cancer patients, those who are black or Hispanic, who live in rural areas with lower incomes, and who live farther from a high-volume hospital are more likely to be treated at a low-volume hospital. Public policies may help change some of these discrepancies, such as those currently instituted in New York and France. However, it remains important to assess whether these regulations positively affect outcomes. The mechanism that drives the volume–outcome relationship in breast cancer survival has yet to be fully elucidated, as does the threshold of procedures or patients treated, which influences outcomes. In addition, high-volume status is an imperfect indicator of better outcomes. Future studies will need to examine the influence of processes of care and factors at the hospital level to explain differences in survival.

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TABLE 1

Clinical and demographic characteristics of 2,777 breast cancer survivors by hospital volume category

Characteristic	Total (*n* = 2777)	Low volume (*n* = 935)	Higher volume (*n* = 1842)	*P*
Demographic				
Age, median (y)	72	73	72	0.47
Race				
White	2513 (90.5%)	815 (87.2%)	1698 (92.2%)	<0.0001
Black	94 (3.4%)	50 (5.3%)	44 (2.4%)	
Hispanic	96 (3.5%)	45 (4.8%)	51 (2.8%)	
Other	74 (2.7%)	25 (2.7%)	49 (2.7%)	
Marital status				
Married	1416 (51.0%)	452 (48.3%)	964(52.3%)	0.05
Not married	1361 (49.0%)	483(51.7%)	878(47.7%)	
Population density				
Urban	1606 (57.8%)	487 (52.1%)	1119 (60.7%)	<0.0001
Suburban	1101 (39.6%)	400 (42.8%)	701 (38.1%)	
Rural	70 (2.5%)	48 (5.1%)	22 (1.2%)	
Socioeconomic status				
Total household annual income (median)	$28,000	$25,000	$30,000	<0.0001
Education				
Eighth grade or less	87 (3.1%)	43 (4.6%)	44 (2.4%)	<0.0001
High school diploma or GED	944 (34.0%)	333 (35.6%)	611 (33.2%)	
Some high school	139 (5.0%)	61 (6.5%)	78 (4.2%)	
Vocational school or some college	793 (28.6%)	266 (28.4%)	527 (28.6%)	
Four-year college degree	443 (15.9%)	132 (14.1%)	311 (16.9%)	
Professional or graduate school	301 (10.8%)	79 (8.4%)	222 (12.0%)	
Missing	70 (2.5%)	21 (2.2%)	49 (2.7%)	
Medicaid insurance				
No	2632 (94.8%)	868 (92.8%)	1764 (95.8%)	0.001
Yes	145 (5.2%)	67 (7.2%)	78 (4.2%)	
Any other insurance besides medicare?				
No	197 (7.1%)	88 (9.4%)	109 (5.9%)	0.0008
Yes	2509 (90.3%)	825 (88.2%)	1684 (91.4%)	
Missing	71 (2.6%)	22 (2.3%)	49 (2.6%)	
Summary emotional support scale, lowest quartile				
No	1948 (70.1%)	629 (67.3%)	1319 (71.6%)	0.03
Yes	725 (26.1%)	267 (28.6%)	458 (24.9%)	
Missing	104 (3.7%)	39 (4.2%)	65 (3.5%)	
Summary tangible support scale, lowest quartile				
No	1855 (66.8%)	614 (65.7%)	1241 (67.4%)	0.50
Yes	813 (29.3%)	280 (29.9%)	533 (28.9%)	
Missing	109 (3.9%)	41 (4.4%)	68 (3.7%)	

Characteristic	Total (*n* = 2777)	Low volume (*n* = 935)	Higher volume (*n* = 1842)	*P*
Distance from nearest hospital (miles), median	3.27	3.23	3.29	0.93
Distance from nearest high-volume hospital (miles), median[a]	19.6	37.8	14.1	<0.0001
Clinical				
SEER stage[b]				
0	439 (15.8%)	140 (15.0%)	299 (16.2%)	0.58
1	1582 (57.0%)	501 (53.6%)	1081 (58.7%)	
2	28 (1.0%)	13 (1.4%)	15 (0.8%)	
3	409 (14.7%)	140 (15.0%)	269 (14.6%)	
4	38 (1.4%)	11 (1.0%)	27 (1.5%)	
5	3 (0.1%)	1 (0.1%)	2 (0.1%)	
Missing	278 (10.0%)	129 (13.8%)	149 (8.1%)	
Comorbidity level				
None	1738 (62.6%)	564 (60.3%)	1174 (63.7%)	0.26
Medium	609 (21.9%)	222 (23.7%)	387 (21.0%)	
High	284 (10.2%)	102 (10.9%)	182 (9.9%)	
Missing	146 (5.3%)	47 (5.0%)	99 (5.4%)	

[a] High volume defined as ≥40 cases annually

[b] For SEER stage, *0* in situ, *1* localized, *2* regional, direct extension, *3* regional, regional lymph nodes only, *4* regional, direct extension and regional lymph nodes, *5* regional, NOS, *6* missing, *7* distant

TABLE 2

Relationship of socioeconomic factors and distance to any hospital or high-volume hospital

Characteristic	Distance to nearest hospital (miles), median	Distance to nearest high-volume hospital (miles), median[a]	*P*
Demographic			
Race			
White	3.4	20.2	0.07
Black	2.2	10.1	
Hispanic	2.6	18.2	
Other	2.5	15.4	
Marital status			
Married	2.9	17.7	0.02
Not married	3.7	21.6	
Population density			
Urban	2.8	12.9	<0.0001
Suburban	4.4	44.4	
Rural	5.1	150.6	
Socioeconomic status			
Total household annual income (median)			
$0–14,999	3.2	22.0	0.02
$15–34,999	3.3	22.6	
$35,000–74,999	3.3	20.1	
$75,000+	3.4	15.0	
Missing	3.2	16.7	
Education			
Eighth grade or less	3.8	33.9	0.03
Some high school	3.3	16.7	
High school diploma or GED	3.6	21.6	
Vocational school or some college	3.5	21.0	
Four-year college degree	2.9	17.3	
Professional or graduate school	2.9	15.0	
Missing	2.7	17.0	
Medicaid			
No	3.3	19.5	0.47
Yes	2.7	22.0	
Any other insurance besides medicare?			
No	3.4	23.4	0.04
Yes	3.3	19.6	
Missing	2.8	17.0	
Summary emotional support scale, lowest quartile			
No	3.3	19.6	0.60

Characteristic	Distance to nearest hospital (miles), median	Distance to nearest high-volume hospital (miles), median[a]	*P*
Yes	3.1	19.8	
Missing	3.4	19.0	
Summary tangible support scale, lowest quartile			
No	3.4	21.1	0.006
Yes	3.0	16.7	
Missing	3.1	18.9	
Clinical			
SEER stage[b]			
0	3.1	17.3	0.56
1	3.2	19.3	
2	5.2	27.5	
3	3.2	18.2	
4	3.0	15.6	
5	5.8	19.3	
Missing	3.8	42.1	
Comorbidity index			
None	3.3	18.7	0.74
Medium	3.4	20.9	
High	2.7	19.2	
Missing	3.5	20.1	

[a] High volume is defined as ≥40 cases annually

[b] For SEER stage, *0* in situ, *1* localized, *2* regional, direct extension, *3* regional, regional lymph nodes only, *4* regional, direct extension and regional lymph nodes, *5* regional, NOS, *6* missing, *7* distant

TABLE 3

Multivariate analysis of variables predicting treatment at a low-volume hospital

Factor	Odds ratio	95% confidence interval	*P*
Race			
White	1.00		0.003
Black	1.93	1.17–3.18	
Hispanic	2.01	1.21–3.35	
Other	1.26	0.71–2.23	
Population density			
Urban	1.00		0.01
Suburban	1.01	0.82–1.25	
Rural	2.67	1.37–5.18	
Total annual household income[a]	0.90	0.87–0.94	<0.0001
Distance from nearest high-volume hospital[b]	1.05	1.03–1.07	<0.0001

Model also adjusted for age, education, comorbidity, medicaid status, having another source of insurance, marital status, emotional/informational support, tangible support, and distance from the nearest hospital

[a] An increase of $10,000 results in an odds ratio of 0.90; 10% less likely to go to a low-volume hospital

[b] The farther you live from the nearest high-volume hospital, the less likely you are to utilize one; an increase of 10 miles from the nearest high-volume hospital increases the odds of utilizing a low-volume hospital by 5%