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Effects of Race and Socioeconomic Status on Survival of 1,332 Black, Hispanic, and White Women with Breast Cancer

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Background: A survival disadvantage for black women with breast cancer, which persists after controlling for stage of the disease, has been reported. This study investigates the effects of race and socioeconomic status (SES) on breast cancer survival after controlling for age, stage, histology, and type of treatment.

Methods: Kaplan-Meier and Cox proportional hazards models were used to analyze the interaction between race and SES in predicting survival in a sample of 163 black, 205 Hispanic, and 964 white women with breast cancer treated at M. D. Anderson Cancer Center (1987–1991).

Results: The results of univariate and multivariate analyses indicate that race was not a significant predictor of survival after adjusting for SES and other confounding factors such as demographic and disease characteristics. SES remained a significant predictor of survival after all adjustments were made. There was no evidence of differences in type of treatment by race or SES if adjustments were made for stage.

Conclusions: These results suggest that institutional factors, such as access to treatment, do not explain survival differences by race or SES. Other factors associated with low SES, such as life-style and behavior, may affect survival.

Key Words: Breast cancer—Survival—Socioeconomic status—Race.

Survival disadvantages have been well documented among black women with breast cancer (1–17) and to a lesser extent among Hispanic women (13,18) when compared with white women. Black and Hispanic women are more likely to present with later stages of cancer (1–3,14,19–26). Adjusting for stage of disease eliminates survival differences for Hispanics (16,17,20) but not for blacks (1–3,6,7,14,16,27).

The reasons for differences in survival for blacks after adjusting for disease stage are not well understood. Possible reasons include physiological differences in tumor characteristics. Some tumor characteristics associated with poorer prognosis are more prevalent among blacks (22,23,27–31) and to a lesser extent among Hispanics (27), whereas the results for other characteristics, histologic types, and estrogen receptors are not clear (3,22,23,27,28). However, differences in tumor characteristics are not sufficient to explain differences in survival by race (7,31).

Differences in socioeconomic status (SES) also may offer an explanation because a third of the nation's poor are black. It is well documented that low SES and poverty adversely affect survival for patients with cancer (1–4,6,8,9,16,32–35). Several studies (3,4,6) found that most or all of the racial differences in survival rates were eliminated after adjusting for SES, but in some studies differences remained (2,16). Socioeconomic factors that may contribute to differences in survival include aspects

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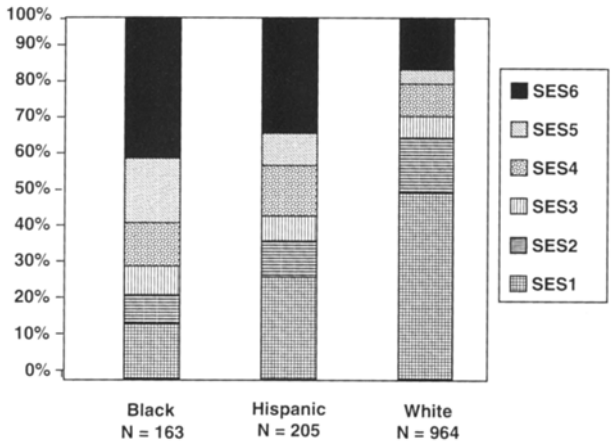

FIG. 1. Race by socioeconomic status (SES). N, number of patients. SES ranges from high (SES1) to low (SES6).

of the health-care system, such as access to health care and quality of care (8,9,11,22,24,26,28,36,37), as well as patient behavior and life-style (5,10,11, 16,22,24,28,38,39).

In order to differentiate the effects of race from those of SES on survival after adjusting for disease stage, we studied patients treated for breast cancer at The University of Texas M. D. Anderson Cancer Center from 1987 to 1991. The sample included a good representation of all socioeconomic groups within the racial groups because M. D. Anderson Cancer Center treats Texas residents independent of their ability to pay (Fig. 1). By restricting the study to newly diagnosed patients of one institution who were not treated elsewhere, differences in quality of care were reduced. Although other studies measured SES indirectly by type of hospital providing care (private vs. public) (40) or by a measure of income based on the median income of the census tract (2,3,6,24,26,37), we used each patient's ability to pay for their treatment based on actual household income adjusted for number of dependents and insurance coverage. This measure should more accurately represent the socioeconomic conditions of individual patients.

MATERIALS AND METHODS

Study Population

The study population included all new patients with a diagnosis of histologically confirmed single primary breast cancer admitted for treatment from 1987 to 1991 at The University of Texas M. D. Anderson Cancer Center (N = 2,690 patients). Of these, 1,358 were excluded because initial treatment had been given elsewhere, reducing the total to 1,332 patients. Demographic information on these patients was collected at registration and included race/ethnicity (black, Hispanic, white), age at diagnosis, and an ability to pay indicator. The hospital classified patients for their ability to contribute to the cost of their care based on income, number of dependents, and insurance coverage. Categories SES1 to SES4, the high and medium SES groups, include a range of patients from those able to pay for all of their treatment regardless of insurance status (SES1) to those responsible for <30% of what is not paid by their insurance (SES4). Indigent patients are grouped into the two lowest SES groups: SES5 comprises those with some insurance, Medicaid, or Medicare, and SES6 comprises those with no insurance who are covered by state funds and charity.

Clinical variables included stage of the disease at diagnosis, histology, treatment administered in the first 4 months, and participation in a clinical research protocol. Patients were staged from their medical charts in the first 4 months after admission into the seven stages of the Surveillance, Epidemiology and End Results (SEER) program of the National Cancer Institute. Histological variables were extracted from the pathology report. From the medical charts, patients were assigned to first course of treatment categories: surgery, chemotherapy, radiotherapy, and combinations of surgery with chemotherapy and radiotherapy. The endocrine and immunotherapy categories included patients who had received those therapies alone or in combination with other treatments. In no case were patients assigned to more than one category.

Statistical Analysis

Survival, measured in months alive after diagnosis, was assessed from January 1987 to September 1992 with a mean follow-up period of 30 months for the entire sample, which numbered 1,332 patients. During the study period, 206 deaths were observed. Only all-cause mortality was used because Eley et al. (1) found no differences in results between all-cause mortality and cancer-specific mortality. Trend and cohort analyses indicated the data could be appropriately pooled over the study period.

Point estimates of the odds ratios and the corresponding large sample 95% confidence intervals were calculated to assess the racial differences in demographic, disease, and treatment characteristics (41). Univariate survival analysis was per-

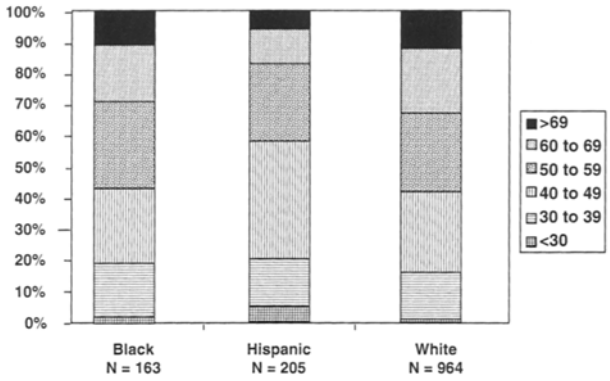

FIG. 2. Race by age. N, number of patients.

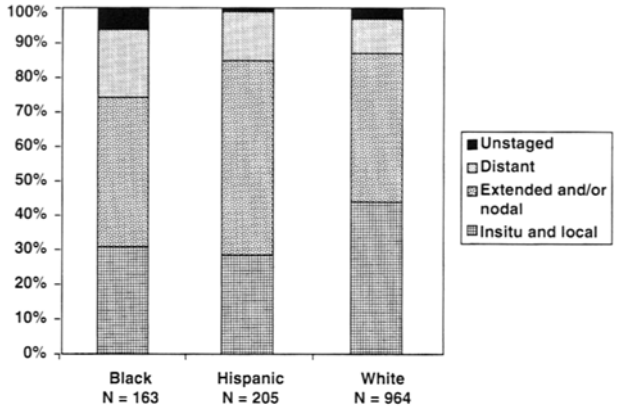

FIG. 3. Race by stages. N, number of patients.

formed with the Kaplan-Meier product limit estimator (42). Differences in the survival curves between subgroups were determined with the Mantel-Cox test and the corresponding trend test for ordinal variables (43). The multivariate Cox proportional hazards model (44) was used to estimate the independent effects of race, age, stage, treatment, SES, and histology on survival after adjusting for the effects of all other factors included in the model. The appropriateness of the proportionality assumption was assessed by residual analysis, and no violations were found. A 5% error level was used throughout the study to test for significance.

RESULTS

As shown in Fig. 2, the age distributions did not differ between blacks and whites, whereas Hispanic women were younger. Blacks and Hispanics were less likely to be in the higher SES groups (SES1 and SES2) and tended to be indigent (SES5 and SES6). Compared with Hispanics, blacks tended to be poorer (Fig. 1). Early-stage disease was less prevalent among black and Hispanic patients than among whites. A higher percentage of blacks had distant-stage disease, and a higher percentage of Hispanics had disease that extended beyond the initial site or involved the nodes. Blacks tended to have more distant metastasis compared with Hispanics (Fig. 3).

Treatment varied by race (Fig. 4) but was explained by differences in disease stage. Blacks and Hispanics received chemotherapy only more often and surgery only less often as initial treatment. Hispanics received surgery/chemotherapy and endocrine therapy more often than did whites. When adjustments were made by stage, the differences in treatment by either race or SES were negligible (Table 1). There were no differences by race or SES in protocol participation, and there was no difference in treatment type between patients on protocol and those not on protocol. There were no differences in histological type by race.

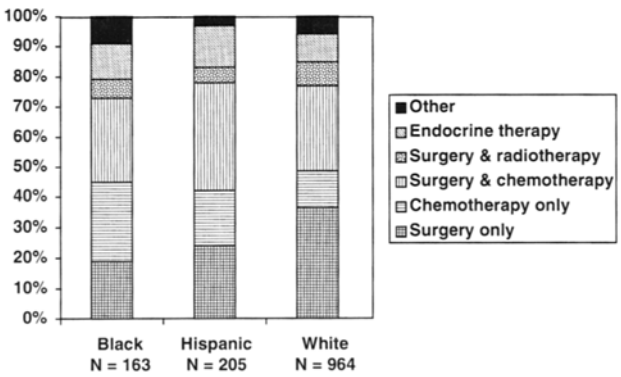

FIG. 4. Race by treatment. N, number of patients.

Univariate Analysis

Univariate analysis was performed on 1,332 patients for whom the date of diagnosis was available. As shown in Table 2 and Fig. 5, survival was significantly different by race ($p = 0.0005$). Except for age, all the demographic and disease characteristics, as well as treatment choices, were significant univariate predictors of survival.

Significant differences in survival still existed across race when stratified by stage ($p = 0.02$). Racial differences in survival were eliminated when the effects of both stage and SES were controlled ($p = 0.15$).

Significant differences were seen in survival by SES ($p < 0.0001$), with those in lower SES categories having poorer survival. These differences per-

TABLE 1. *Odds ratios for treatment within stage by race and SES*

Stage and treatment	Black (n = 163) vs. white (n = 964)		Hispanics (n = 205) vs. white (n = 964)		Low SES (n = 358) vs. high/medium SES (n = 974)	
	Odds ratio[a]	95% Confidence interval	Odds ratio[b]	95% Confidence interval	Odds ratio[c]	95% Confidence interval
Local						
Surgery only	0.62	0.33–1.16	1.09	0.61–1.93	0.87	0.54–1.39
Surgery/chemotherapy	1.34	0.63–2.85	0.80	0.36–1.78	1.49	0.83–2.66
Extended stage						
Surgery/chemotherapy	0.67	0.06–7.48	2.00	0.24–16.94	1.14	0.24–5.43
Nodal involvement						
Surgery only	0.51	0.17–1.55	0.62	0.28–1.35	0.44[d]	0.22–0.88
Surgery/chemotherapy	0.88	0.42–1.81	1.02	0.58–1.77	1.32	0.83–2.13
Extended and nodal						
Surgery/chemotherapy	1.63	0.77–3.46	2.14[d]	1.10–4.19	0.11	0.51–1.61
Distant stage						
Chemotherapy only	2.23	0.94–5.27	0.73	0.32–1.66	0.55	8.29–1.04

Only the more frequent treatments within each stage are reported.
[a] Odds of index category among black subjects divided by odds of index category among white subjects. [b]Odds of index category among Hispanic subjects divided by odds of index category among white subjects. [c]Odds of index category among low SES subjects divided by odds of index category among high/medium SES subjects.
[d] Significant at 5% error level.

sisted after adjusting for stage ($p = 0.003$) and for stage and race ($p = 0.008$).

Multivariate Analysis

The joint impact of several variables on survival were considered in a Cox proportional hazards model with the 1,332 patients (Table 3). The categories of age, stage, protocol participation, treatment choices, and SES were found to be significant independent predictors of survival ($p < 0.05$). Race and histology were not significant. The relative risk of blacks when compared with whites, although positive, was not significant when adjustments were made for SES, other demographic and disease characteristics, and treatment choices. No significant differences existed for Hispanics relative to whites.

As expected, those with disease in later stages (extended/nodal involvement and distant metastasis) and those unstaged had a higher relative risk than did those with early-stage cancers (in situ and local). Patients who received chemotherapy only had higher relative risk than did those who underwent surgery only. Age was a significant prognostic indicator of survival: women <30 and those >60 years of age had higher relative risk than did those 40–49 years of age. Indigent patients (SES6) had a higher relative risk than did financially secure patients (SES1).

To investigate the relationship between race and SES, several Cox proportional hazards models were run (Table 4). Black women with breast cancer had a 98% excess risk of death over white women. When controlling for all prognostic variables in the model, black women continued to demonstrate a slightly increased but not significant excess risk of 34%. This implies that the prognostic variables in this model explain 66% of the unadjusted excess risk. Stage and SES were strong contributors to survival differences, accounting for 38% and 45% of the unadjusted excess risk, respectively. Including SES in the model with all other

TABLE 2. *Summary of probability values for univariate predictors of survival*

Variable	p[a]
Age stage	0.33[b]
Treatment	<0.0001
Protocol	<0.0001
Histology	0.03
Race	0.007
Race adjusted for stage	0.0005
Race adjusted for stage and SES	0.02
SES	0.15
SES adjusted for stage	<0.0001[b]
SES adjusted for stage and race	0.003[b]
	0.008[b]

Age categories are <30, 30–39, 40–49, 50–59, 60–69, and ≥70 years. SEER summary stage includes in situ and local, extended, nodal involvement, extended plus nodal involvement, distant, and unstaged. Treatment variables include surgery only, chemotherapy only, radiotherapy only, surgery and chemotherapy, surgery and radiotherapy, endocrine therapy, and immunotherapy. Histology variables include infiltrating duct carcinoma, lobular, and in situ histology. SES variables range from SES1 (high SES) to SES6 (low SES).
[a] Mantel Cox test.
[b] The trend version of the Mantel Cox test is used.

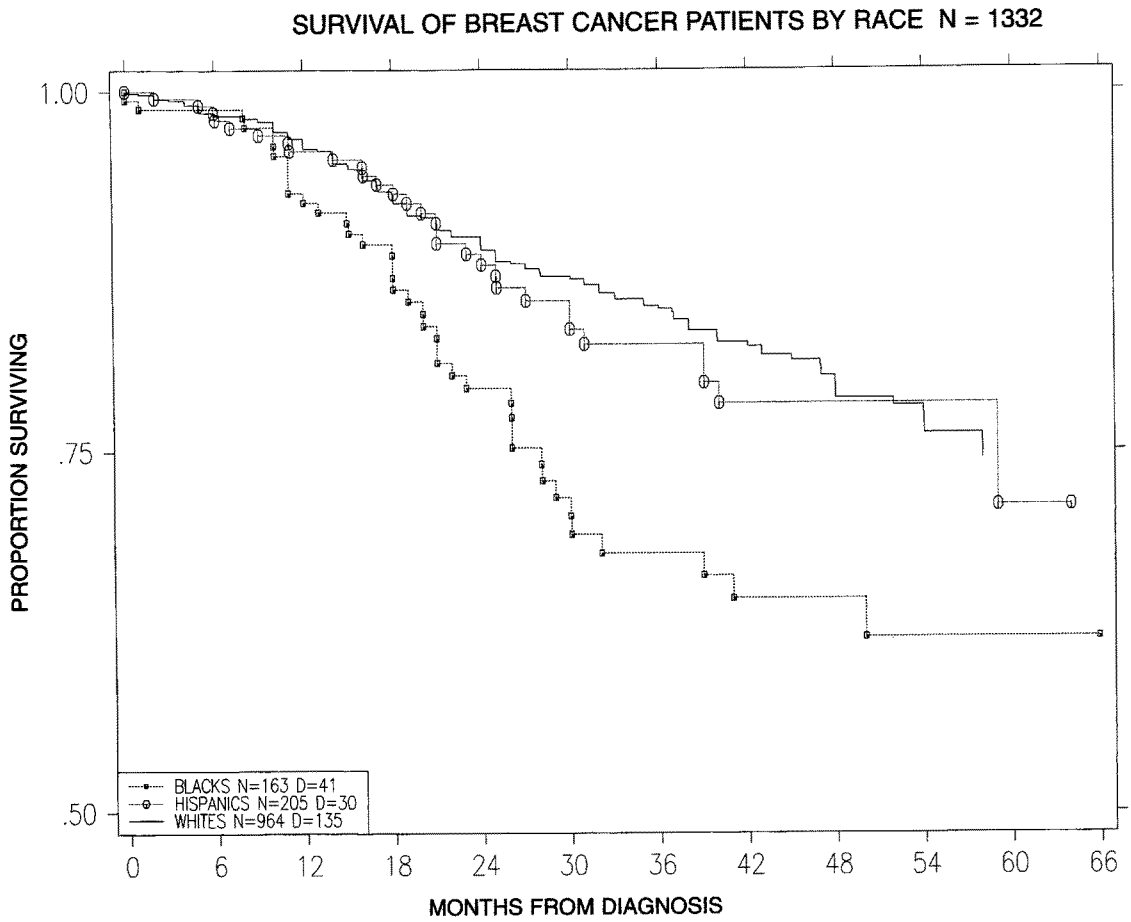

FIG. 5. Survival of breast cancer patients by race (n = 1,332). N, number of patients; D, number of deaths.

prognostic factors decreased the excess risk for black women by 31%, which may indicate that race acts as a proxy for the missing SES variable. If an appropriate SES indicator had not been included, the model would have produced a biased estimate of the effect of race on survival, largely crediting race with effects associated with SES.

DISCUSSION

Hispanic women with one primary breast cancer were found to be poorer and to present with more advanced disease compared with white women but less so than black patients. When adjusting for stage, survival for Hispanic women did not significantly differ from that of white women. These results are consistent with those of other studies (16, 17,20,24).

Independent of stage, survival for black women with breast cancer was less than for white women, a result consistent with those of other studies (1–17). This is partly attributable to a larger percentage of blacks (20%) with distant-stage disease than whites with distant-stage disease (10%). But even after adjusting for stage, significant racial differences in survival persisted, a result consistent with those of several other studies (1–3,6,7,14,16,27).

This study concentrated on the contribution of SES, with a more definitive measure based on family income, in explaining the survival disadvantage in black women. An important question was whether race itself is the cause of differences in survival or whether race acts as a proxy for SES. Our univariate and multivariate analyses point to the latter and support Freeman's (8) arguments because no significant racial differences appeared in survival after adjusting for stage and SES. Similar conclusions were reached by Bassett and Kreiger (3) and Dayal et al. (6) using SES indicators from the census block groups and tracts, respectively. Cella et

TABLE 3. *Multivariate analysis Cox proportional hazards model*

Characteristics	Relative risk	95% CI
Age (yr)		
<30	3.48[a]	1.53–7.90
30–39	1.49	0.93–2.39
40–49	1.00	
50–59	1.28	0.85–1.92
60–69	2.16[a]	1.39–3.35
>70	2.42[a]	1.38–4.26
Race		
Black	1.34	0.91–1.96
Hispanic	0.87	0.57–1.33
White	1.00	
SES		
1	1.00	
2	1.08	0.69–1.70
3	0.75	0.37–1.54
4	1.47	0.93–2.32
5	1.11	0.60–2.05
6	1.69[a]	1.15–2.48
SEER summary stage		
In situ and local	1.00	
Extended	2.10	0.71–6.22
Nodal involvement	1.38	0.76–2.51
Extended and nodal	4.91[a]	2.83–8.51
Distant	14.27[a]	7.96–25.59
Unstaged	4.26[a]	1.85–9.84
Treatment		
Surgery only	1.00	
Chemotherapy only	2.49[a]	1.48–4.22
Radiotherapy only	0.86	0.20–3.73
Surgery and chemotherapy	1.54	0.92–2.56
Surgery and radiotherapy	0.61	0.24–1.57
Endocrine therapy	1.27	0.74–2.20
Immunotherapy	0.48	0.06–3.69
Protocol	0.65[a]	0.47–0.90
Histology		
Other histology	1.34	0.80–2.25
Infiltrating duct carcinoma	1.00	
Lobular histology	0.60	0.26–1.37
In situ carcinoma	0.40	0.05–2.96

CI, confidence interval.
[a] Significant at 5% error level.

TABLE 4. *Risk of death among blacks compared with whites in selected proportional hazards models*

Variables in the model	RR	95% CI
Race	1.98	1.40–2.81
Race, SES	1.54	1.06–2.23
Race, stage	1.61	1.13–2.29
Race, stage, age, treatment, histology, protocol	1.49	1.04–2.14
Race, stage, age, treatment, histology, protocol, SES	1.34	0.91–1.96

Age categories are <30, 30–39, 40–49, 50–59, 60–69, and ≥70 years. SEER summary stage includes in situ and local, extended, nodal involvement, extended plus nodal involvement, distant, and unstaged. Treatment variables include surgery only, chemotherapy only, radiotherapy only, surgery and chemotherapy, surgery and radiotherapy, endocrine therapy, and immunotherapy. Histology variables include infiltrating duct carcinoma, lobular, and in situ histology. SES variables range from SES1 (high SES) to SES6 (low SES).
RR, relative risk; CI, confidence interval.

al. (4) found that self-reported income, but not race, was significant in a Cox proportional hazards model explaining survival for five cancer sites. However, the evidence is far from conclusive because the inclusion of SES did not explain the racial differences in survival in other studies (1,2,16).

In an effort to understand the process through which SES affects the survival of breast cancer patients, researchers have cited the impact of institutional factors and of patient behavior associated with low SES. Some studies have identified institutional factors such as reduced access to health care (22), being underinsured (8,9,36), less screening activity (22,26), and going to free instead of private institutions (40) as affecting survival. In this study many of the institutional factors have been addressed by considering only M.D. Anderson patients. Because M.D. Anderson has a legal obligation to treat all Texas residents independent of their ability to pay, access to health care for these patients does not depend on SES or insurance coverage. Also, in these data there was no evidence of bias in the selection of treatment by race or SES at M.D. Anderson, which reflects institutional policy but may differ from the general practice in other treatment settings. However, more subtle differences in treatment aggressiveness within the treatment categories could not be investigated with the available data. Other studies have investigated differences in staging and treatment by race, but not conclusively (2,5,11,22,28,37).

These considerations would in any case suggest that institutional factors have not been sufficient to explain survival differences by race and SES in breast cancer patients and that other aspects of low SES affect survival. Other studies have investigated possible links between survival and patient behavior, such as delay in symptom recognition, delay in obtaining a medical consultation, (10,16,22,24,39), and noncompliance (38). Another aspect of low SES affecting survival may be decreased host resistance (38) due to poorer nutritional status (5), a higher prevalence of obesity (5,22,23), and poorer overall health status (28).

Several studies have documented differences in tumor characteristics between black and white patients with breast cancer (1,3,22,23,27–31). Those differences partly explained but did not remove the survival disadvantage of black cancer patients (7,31). With the available data, the differences by race in physiological properties of the tumor, an-

other possible explanation of racial differences in survival, could not be explored.

The limitations of the available physiological prognostic factors and the use of censored data (84%) restrict the kinds of conclusions that might be made about survival. The relatively short period of follow-up for patients with breast cancer (5 years) may be adequate in a sample with a large proportion of patients with advanced disease.

This research indicates that better specification of preventive behavior associated with SES may be important in elucidating the link between SES, race, and survival. Better understanding of the process through which SES affects the survival of cancer patients could result in more effective public health interventions.

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