Original Article

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Impact of Socioeconomic Factors on Surgical Approach and Outcomes in Young Women with Breast Cancer

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ABSTRACT

Objective: Breast cancer treatment disparities persist and include surgical approach. This study evaluated the association of race, ethnicity, employment, and insurance status with the selected surgical approach and the effect on recurrence-free survival (RFS) and overall survival (OS) in young women with breast cancer.

Materials and Methods: A retrospective review of a prospectively maintained institutional database (Sandra Levine Young Women's Breast Cancer Program) identified women aged ≤40 years diagnosed with non-metastatic breast cancer from 2010–2019 who underwent surgery. Multivariable logistic regression models and Cox proportional-hazards models were fitted.

Results: Of the 700 women, 4% were Asian, 26% Black, and 69% White. Reported ethnicity was: 67% non-Hispanic, 5% Hispanic, and 27% unknown or unreported. Clinical stage distribution was 86% early stage (0–II) and 11% stage III. Among patients with invasive cancer (n = 624), 51% were hormone receptor (HR)-positive/human epidermal growth factor receptor 2 (HER2)-negative, 21% were HR-negative/HER2-negative, 20% were HR-positive/HER2-positive, and 8% were HR-negative/HER2-positive. Local, regional, or distant recurrence occurred in 13.1% of patients who underwent lumpectomy and in 16.4% of those who underwent mastectomy (p = 0.22). Death occurred in 6.5% of patients after lumpectomy and in 10.7% of patients after mastectomy (p = 0.07). Black women were more likely to undergo lumpectomy than White women [odds ratio = 2.26; 95% confidence interval (CI), 1.49–3.43; p<0.001; adjusted for ethnicity]. Private insurance was associated with improved OS (hazard ratio = 2.47; 95% CI, 1.26–4.84; p = 0.003) and RFS (hazard ratio = 2.02; 95% CI, 1.28–3.20; p = 0.010) compared with Medicaid. No association was noted between employment status and surgical approach, OS, or RFS.

Conclusion: Young Black women were more likely than White women to elect the less-invasive surgery (lumpectomy). Private insurance was associated with better OS and RFS.

Keywords: Breast cancer; disparities; lumpectomy; mastectomy; surgical approach; young women

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Key Points

- Young Black women with breast cancer were more likely to elect less invasive surgery, lumpectomy, compared to young White women.
- Surgical approach did not impact overall survival or recurrence rates.
- Private insurance was associated with increased overall and recurrence-free survival.

Introduction

Social determinants of health are increasingly being studied to understand their impact on breast cancer outcomes. However, most studies have included postmenopausal women. It is unclear whether racial and socioeconomic disparities in breast cancer diagnosis, stage at presentation, and outcomes persist among women aged 40 years and younger. Social determinants of health include race, ethnicity, education, employment status, income, access to transportation, and insurance status. There are known racial and socioeconomic disparities in diagnosis, stage at presentation, and outcomes among patients with breast cancer (1). Specifically, existing literature indicates that Black and Hispanic patients are more likely than White patients to present with late-stage disease, in part because of limited access to

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healthcare, inadequate insurance coverage for screening tests, and delays in diagnosis (2, 3). Black patients with breast cancer also have higher mortality, which has recently been confirmed in two large national database studies (4, 5). Additional studies indicate that having Medicaid or being uninsured, and residing in a rural location, are associated with increased mortality, independent of race (6-8). However, studies evaluating the impact of socioeconomic factors on breast cancer outcomes have primarily included postmenopausal women.

The data on choice of surgical approach by race have been mixed. Some data suggest that mastectomy rates are higher among Black women, while other data suggest that Black women are more likely to undergo breast-conserving therapy. This variability has been suggested to be related to socioeconomic status, while others report it to be independent (9-12). Specifically, in North Carolina, home to our institution, the rate of mastectomy usage has been declining, a trend that continues even among Black women and women of all races residing in rural areas (13).

We aimed to evaluate the relationships of race and ethnicity, employment status, and insurance status with surgical approach among young women with breast cancer. The secondary analysis aimed to determine recurrence-free survival (RFS) and overall survival (OS) by race, stratified by surgical approach.

Materials and Methods

Data Source

Following institutional review board approval from the Wake Forest School of Medicine, we retrospectively reviewed the Sandra Levine Young Women's Breast Cancer Program's prospectively maintained database at Atrium Health Levine Cancer. Women aged ≤40 years who were diagnosed with ductal carcinoma *in situ* (DCIS) or invasive breast cancer between 2010 and 2019 and who underwent lumpectomy or mastectomy were included. Patients with metastatic disease, those with a concurrent cancer diagnosis, and those with missing treatment and/or follow-up data were excluded. Data pertaining to patient demographics, clinical characteristics, surgical approach, and oncologic outcomes were collected. Insurance status was categorized as private, Medicaid, Medicare, or self-pay/uninsured. Employment was categorized as employed (part-time or full-time), unemployed, or unknown. Receptor status groups were categorized as hormone receptor (HR)-positive and human epidermal growth factor receptor 2 (HER2)-positive (HR+/HER2+), HR-positive and HER2-negative (HR+/HER2-), HR-negative and HER2-positive (HR-/HER2+), and HR-negative and HER2-negative (HR-/HER2-; triple-negative). OS was calculated as the time from diagnosis to death from any cause, or was censored at last follow-up. RFS was calculated as the time from diagnosis to recurrence or death, or was censored at the last assessment date.

Statistical Analysis

Patients' demographic and clinical characteristics were compared between lumpectomy and mastectomy cohorts using descriptive statistics. For continuous variables, means and standard deviations were reported, while categorical variables were reported as frequencies and percentages. Corresponding *p*-values were calculated using the chi-square or Fisher's exact test for categorical variables and the two-sample t-test for continuous variables. Univariate and multivariable logistic regression analyses were performed to evaluate whether race, ethnicity, insurance type, and employment status were associated with the surgical approach. The Kaplan-Meier method was used to estimate OS and RFS across groups. Differences among primary groups of interest, including race, insurance type, and employment status, were assessed using log-rank tests. Cox proportional hazards models were used to analyze the associations between outcomes (OS and RFS) and the primary factors of interest: race, insurance type, and employment status. Additional risk factors for these outcomes were evaluated using stepwise model selection procedures in which all covariates were first included in univariate analyses, and those with $p<0.10$ were entered into the multivariable model. Covariates with a *p*-value <0.1 were retained in the base model. Race, insurance status, and employment status were then added to this base model to develop the final model. All statistical tests were two-sided, and a *p*-value <0.05 was considered statistically significant.

Results

Demographics and Clinical Characteristics

A total of 1,084 female patients diagnosed with DCIS or invasive breast cancer were identified in our Sandra Levine Young Women's Program breast cancer database. After excluding patients older than 40 years or with missing date of diagnosis, metastatic disease at presentation, a history of other cancer, or missing treatment data, 700 patients were included in the analyses (Figure 1). Of these women, 69% (*n* = 480) were White, 26% (*n* = 184) were Black, 4% (*n* = 28) were Asian, 1% (*n* = 7) were American Indian or Alaska Native, and 0.1% (*n* = 1) were Native Hawaiian or Pacific Islander (Table 1). Reported ethnicity was 67% (*n* = 472) non-Hispanic, 5% (*n* = 37) Hispanic, and 27% (*n* = 191) unknown or unreported. Disease stage at presentation was: stage II, 44% (*n* = 311); stage I, 28% (*n* = 198); stage 0, 14% (*n* = 96); stage III, 11% (*n* = 76); and unknown, 3% (*n* = 19). Of patients with invasive cancer (*n* = 624), 51% (*n* = 317) were HR+/HER2-, 21% (*n* = 133) HR-/HER2-, 20% (*n* = 126) HR+/HER2+, and 8% (*n* = 48) HR-/HER2+.

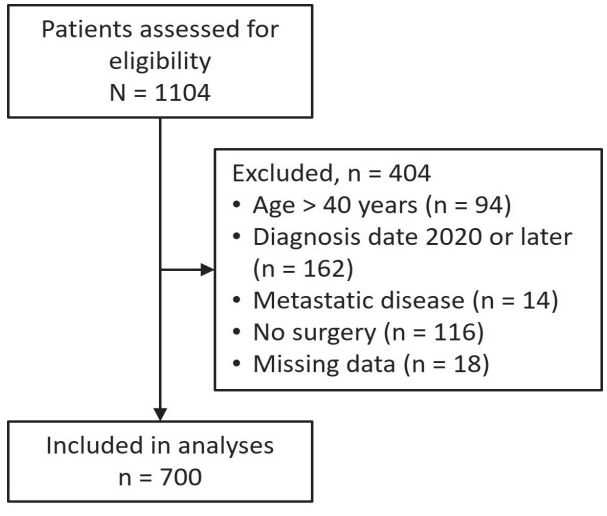

Figure 1. Study diagram

Table 1. Patient demographics and clinical characteristics by surgical approach

Characteristic	Total (*n* = 700)	Lumpectomy (*n* = 260)	Mastectomy (*n* = 440)	*p*-value
Age, years (mean ± SD)	36±3.8	36±4.0	36±3.7	0.10
Race, n (%)				<0.001
American Indian or Alaska Native	7 (1.0)	3 (1.2)	4 (0.9)	
Asian	28 (4.0)	7 (2.7)	21 (4.8)	
Black or African American	184 (26.3)	93 (35.8)	91 (20.7)	
Native Hawaiian or Pacific Islander	1 (0.1)	1 (0.4)	0 (0)	
White or Caucasian	480 (68.6)	156 (60)	324 (73.6)	
Ethnicity, n (%)				0.58
Hispanic or Latino	37 (5.3)	15 (5.8)	22 (5.0)	
Non-Hispanic or non-Latino	472 (67.4)	170 (65.4)	302 (68.6)	
Unknown or not reported	191 (27.3)	75 (28.8)	116 (26.4)	
Insurance status, n (%)				0.47
Private	544 (77.7)	197 (75.8)	347 (78.9)	
Medicare	11 (1.6)	4 (1.5)	7 (1.6)	
Medicaid	93 (13.3)	35 (13.5)	58 (13.2)	
Self-pay or uninsured	46 (6.6)	22 (8.5)	24 (5.5)	
Unknown	6 (0.86)	2 (0.77)	4 (0.91)	
Employment status, n (%)				0.82
Unemployed	140 (20.0)	49 (18.8)	91 (20.7)	
Employed†	543 (77.6)	205 (78.8)	338 (76.8)	
Unknown	17 (2.4)	6 (2.3)	11 (2.5)	
Clinical TNM stage, n (%)				<0.001
Stage 0	96 (13.7)	40 (15.4)	56 (12.7)	
Stage I	198 (28.3)	78 (30.0)	120 (27.2)	
Stage II	311 (44.4)	120 (46.2)	191 (43.4)	
Stage III	76 (10.9)	12 (4.6)	64 (14.5)	
Unknown	19 (2.7)	10 (3.8)	9 (2.0)	
Invasive status, n (%)				0.66
Non-invasive (DCIS)	76 (10.9)	30 (11.5)	46 (10.5)	
Invasive	624 (89.1)	230 (88.5)	394 (89.5)	
Receptor status*, n (%)				0.68
HR+/HER2+	126 (20.2)	43 (18.7)	83 (21.1)	
HR+/HER2-	317(50.8)	114 (49.6)	203 (51.5)	
HR-/HER2+	48 (7.7)	20 (8.7)	28 (7.1)	
HR-/HER2-	133 (21.3)	53 (23.0)	80 (20.3)	
Recurrence status, n (%)				0.22
Yes	106 (15.1)	34 (13.1)	72 (16.4)	
No	580 (82.9)	222 (85.4)	358 (81.4)	
Unknown or not reported	14 (2.00)	4 (1.5)	10 (2.3)	
Survival status, n (%)				0.07
Alive	636 (90.9)	243 (93.5)	393 (89.3)	
Dead	64 (9.14)	17 (6.5)	47 (10.7)	

†: Part-time and full-time employment

*: Receptor status reported for those with invasive disease (*n* = 624)

DCIS: Ductal carcinoma *in situ*; HR: Hormone receptor; SD: Standard deviation; HER2: Human epidermal growth factor receptor 2; HR: Hormone receptor

Regarding insurance status, 78% (n = 544) had private insurance, 2% (n = 11) had Medicare, 13% (n = 93) had Medicaid, and 7% (n = 46) were uninsured. The majority of both Black (66%, 121 of 184) and White (82%, 392 of 480) women had private insurance, while 23% (42 of 184) of Black women and 10% (48 of 480) of White women had Medicaid (Table 2). When employment status was examined, 78% (n = 543) were employed, 20% (n = 140) were not employed, and 2% (n = 17) had an unknown employment status. A majority of both Black and White women were employed: 82% (151 of 184) and 77% (368 of 480), respectively.

Surgical Approach

Of the 700 young women, 37% (n = 260) underwent lumpectomy while 63% (n = 440) underwent mastectomy. There was no significant difference in recurrence rates between the surgical approach groups [13% (n = 34) for lumpectomy vs 16% (n = 72) for mastectomy; p = 0.22]. Among the 106 participants who experienced a recurrence, 25% (n = 27) were local, 10% (n = 11) were regional, 58% (n = 61) were distant, and 7% (n = 7) were unspecified. No significant difference in recurrence location was observed by surgical approach (p = 0.21). There was no significant difference in death rates between the surgical approach groups [6.5% (n = 17) for lumpectomy *vs.* 10.7% (n = 47) for mastectomy; p = 0.07].

In multivariable logistic regression analysis, young Black women were significantly more likely to undergo lumpectomy than young White women [odds ratio (OR) = 2.26; 95% confidence interval (CI), 1.49–3.43; p<0.001; Figure 2], a finding that was consistent across all receptor subtypes. There was no statistically significant association between surgical approach and ethnicity (OR = 1.49; 95% CI, 0.74–2.99; p = 0.262).

Table 2. Insurance type and employment status by race

Characteristic	Race			*p*-value
	Black (n = 183)	White (n = 476)	Other (n = 35)	
Insurance type, n (%)				<0.001
Private	121 (66.1)	392 (82.4)	31 (88.6)	
Medicare	6 (3.3)	5 (1.1)	0 (0.0)	
Medicaid	42 (23.0)	48 (10.1)	3 (8.6)	
Self-pay/uninsured	14 (7.7)	31 (6.5)	1 (2.9)	
Employment status, n (%)				0.10
Unemployed	27 (14.7)	102 (21.3)	11 (30.6)	
Employed	151 (82.1)	368 (76.7)	24 (66.7)	
Unknown	6 (3.3)	10 (2.1)	1 (2.8)	

Rounded percentages may not sum to 100

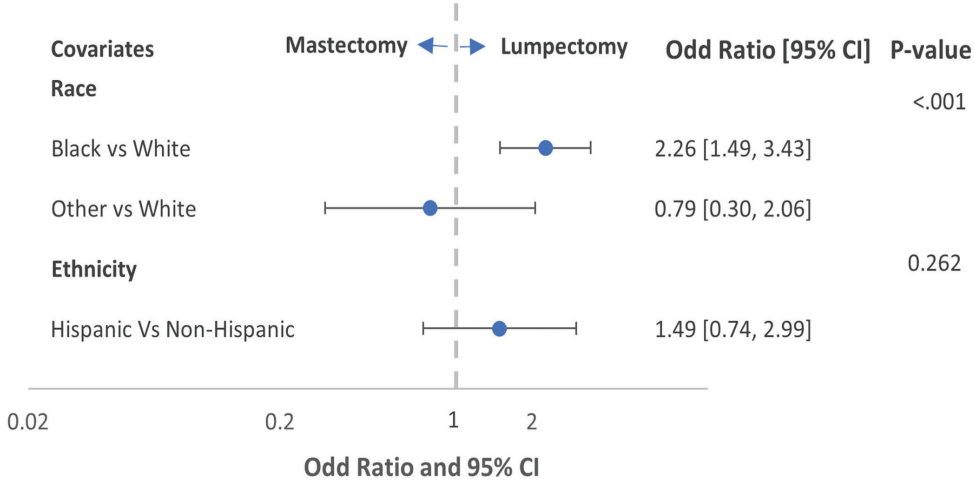

Figure 2. Forest plot depicts odd ratios, along with corresponding 95% confidence intervals (CIs) and p-values, categorized by racial and ethnic subgroups

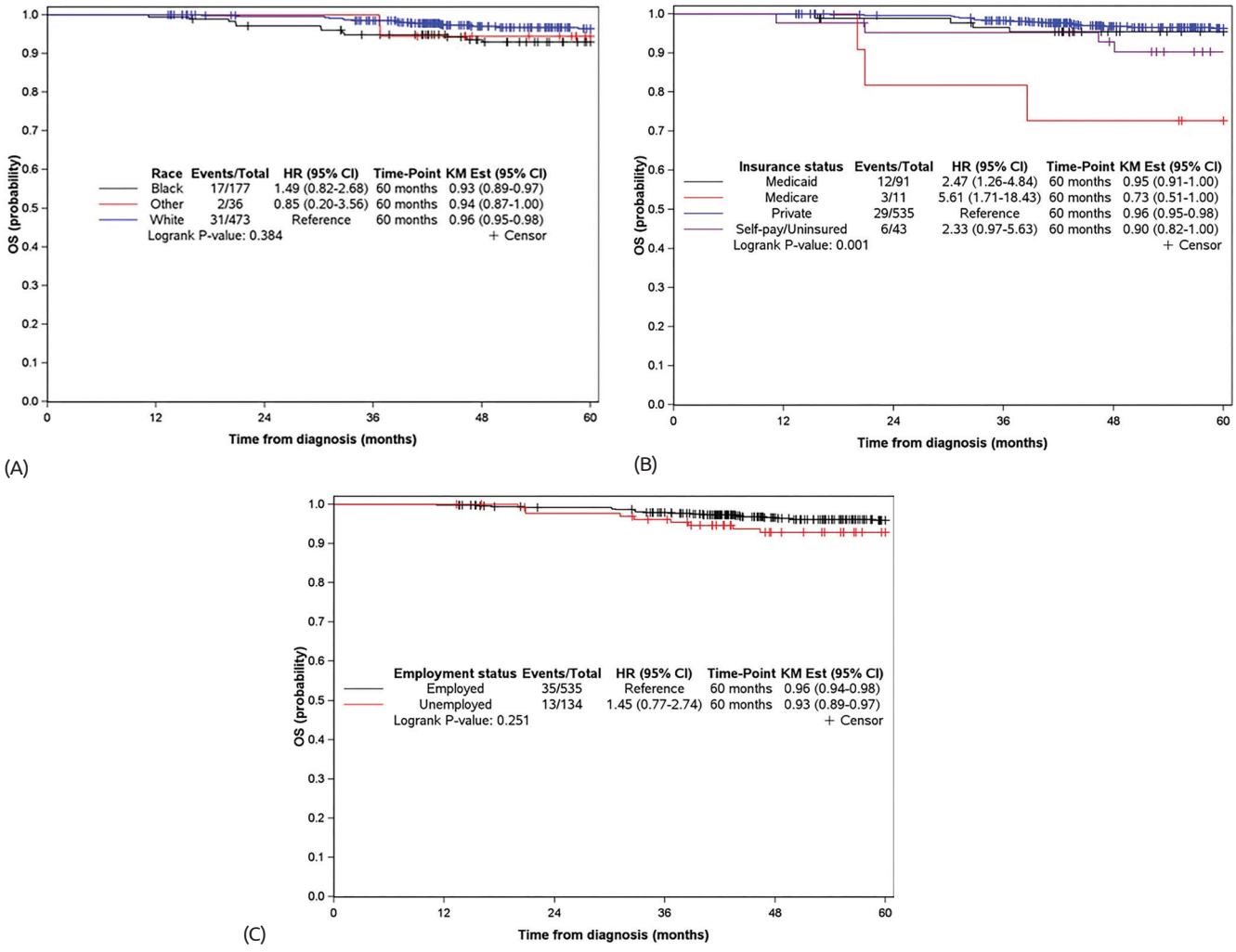

Figure 3. Kaplan-Meier curves of overall survival by race (A), insurance status (B), and employment status (C)

The effect of health insurance status on surgical approach was not significant in univariate analysis (p = 0.49) or in multivariable interaction analysis (p = 0.73); these analyses were performed to control for previously reported significant effects of race on surgery type. Similarly, there was no significant effect of insurance status or ethnicity on surgical choice (p = 0.57). There was no difference in surgical approach between employed and not employed (OR = 0.89; 95% CI, 0.60–1.31; p = 0.55). This was true across all races (p = 0.50) and ethnicities (p = 0.14).

Overall Survival

Kaplan-Meier curves demonstrate no difference in OS by race (Figure 3A). OS was significantly worse in patients with Medicaid or Medicare than in patients with private insurance (Figure 3B). There was no difference in survival by employment status (Figure 3C).

On univariate analysis, there was no significant effect of race on OS (p = 0.39). There were statistically significant differences in OS between Medicaid and private insurance (hazard ratio = 2.47; 95% CI: 1.26–4.84) and between Medicare and private insurance (hazard ratio = 5.61; 95% CI: 1.71–18.4) (overall p = 0.003). There was no significant difference in OS (p = 0.25) based on employment status. Younger women had an increased risk of death [HR per 1-yr increase = 0.92 (95% CI, 0.86–0.98); p = 0.008]; however, there was no significant effect of age decade on OS (p = 0.61). Those with HR-/HER2- receptor status had an increased risk of death compared to those with HR+/Her2- receptor status (hazard ratio = 2.39; 95% CI, 1.24–4.60; p = 0.03). OS differed significantly between clinical stage 0 and clinical stage III (hazard ratio = 0.05; 95% CI, 0.01–0.36; p = 0.001), between clinical stage I and clinical stage III (hazard ratio = 0.21; 95% CI, 0.09–0.48; p = 0.001), and between clinical stage II and clinical stage III (hazard ratio = 0.37; 95% CI, 0.19–0.71; p = 0.001). The final multivariable model included race, insurance status, employment status, age, clinical stage, and receptor status. In multivariable analysis, young women with Medicaid or Medicare had an increased risk of death compared with young women with private insurance (overall p = 0.03) (Figure 4).

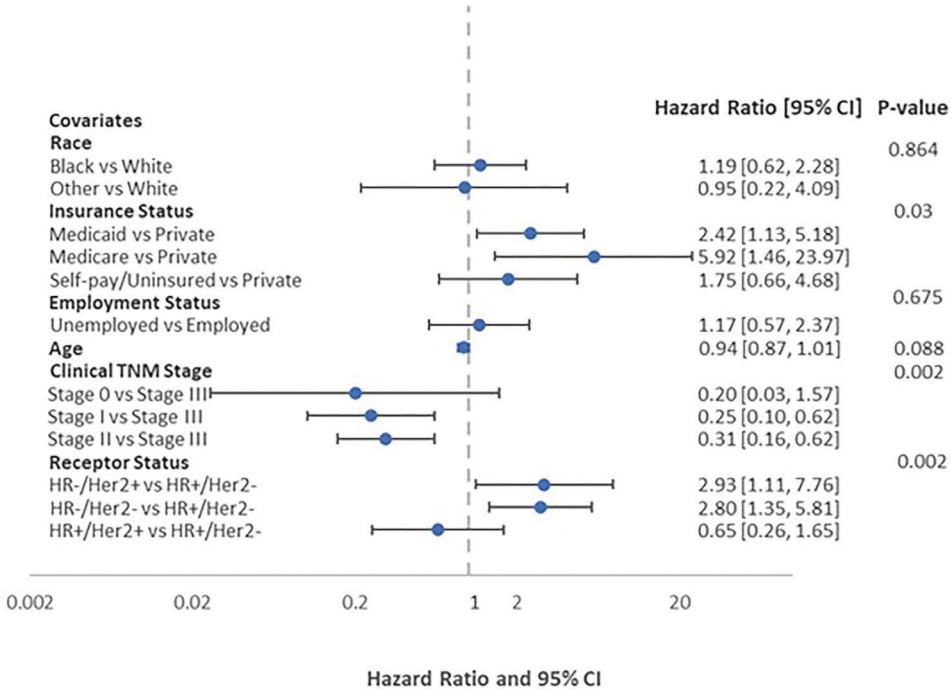

Figure 4. Forest plot depiction of the multivariable model of overall survival

Recurrence-Free Survival

Kaplan-Meier curves show greater RFS in young White patients with breast cancer (p = 0.009; Figure 5A) and in those with private insurance (p = 0.008; Figure 5B). RFS was not significantly associated with employment status (p = 0.35) (Figure 5C). In univariate analysis, young Black women had a significantly increased risk of recurrence compared with young White women (hazard ratio = 1.64; 95% CI, 1.12–2.42; p = 0.01). A statistically significant difference in RFS was observed between Medicaid and private insurance (hazard ratio = 2.02; 95% CI, 1.28–3.20; p = 0.01). There was no significant difference in RFS (p = 0.35) based on employment status. Younger women had an increased risk of recurrence [HR per 1-year increase = 0.94 (95% CI 0.90–0.98); p = 0.006]; however, there was no significant effect of age decade on RFS (p = 0.13). The final multivariable model included race, insurance and employment status, age, diabetes, clinical stage, and receptor status. In multivariable analysis, neither race nor insurance status was associated with an increased risk of recurrence (Figure 6).

Discussion and Conclusion

For young women diagnosed with breast cancer, the choice of surgical procedure is influenced by numerous factors, making it a complex decision. Within our large cohort of young women diagnosed with breast cancer, Black women were more likely to undergo a lumpectomy than White women. However, the surgical approach did not affect OS or recurrence rates. Employment status was associated with neither surgical approach nor survival outcomes. Although health insurance status was not associated with surgical approach among young women with breast cancer, private insurance was associated with improved OS and RFS. A previous study found that 50% of racial disparities could be related to insurance status (14). Other studies have shown that patients with Medicaid and Medicare have worse outcomes—including OS and RFS—than those with private insurance (15-20). These disparities have been linked to factors such as late-stage diagnosis, treatment delays, coverage disruptions, a high comorbidity burden, reduced treatment adherence, and other socioeconomic determinants of health (i.e., transportation, housing, caregiving responsibilities, and work constraints). Unfortunately, many of these individual factors were not captured in our dataset, limiting our ability to further analyze the specific reasons for poor outcomes in our Medicaid and Medicare populations.

Our study has several strengths that support the conclusions drawn. Our Sandra Levine Young Women's Program database represents a large, prospectively maintained source with median follow up of 6.25 years. This allows us to evaluate recurrence and survival over a 5-year follow-up period. This large dataset allows for robust statistical analysis. Additionally, this study builds upon previous work by our group demonstrating no differences in recurrence or survival by surgical approach among young women with breast cancer (15, 16). This report adds to a growing body of literature examining differences in treatment and outcomes of young women with breast cancer.

The study was limited by the retrospective nature of the data review; however, as previously mentioned, the database is prospectively updated and maintained. A large cohort of women (n = 191) had missing ethnicity data, which we presume was due to a lack of clarity in

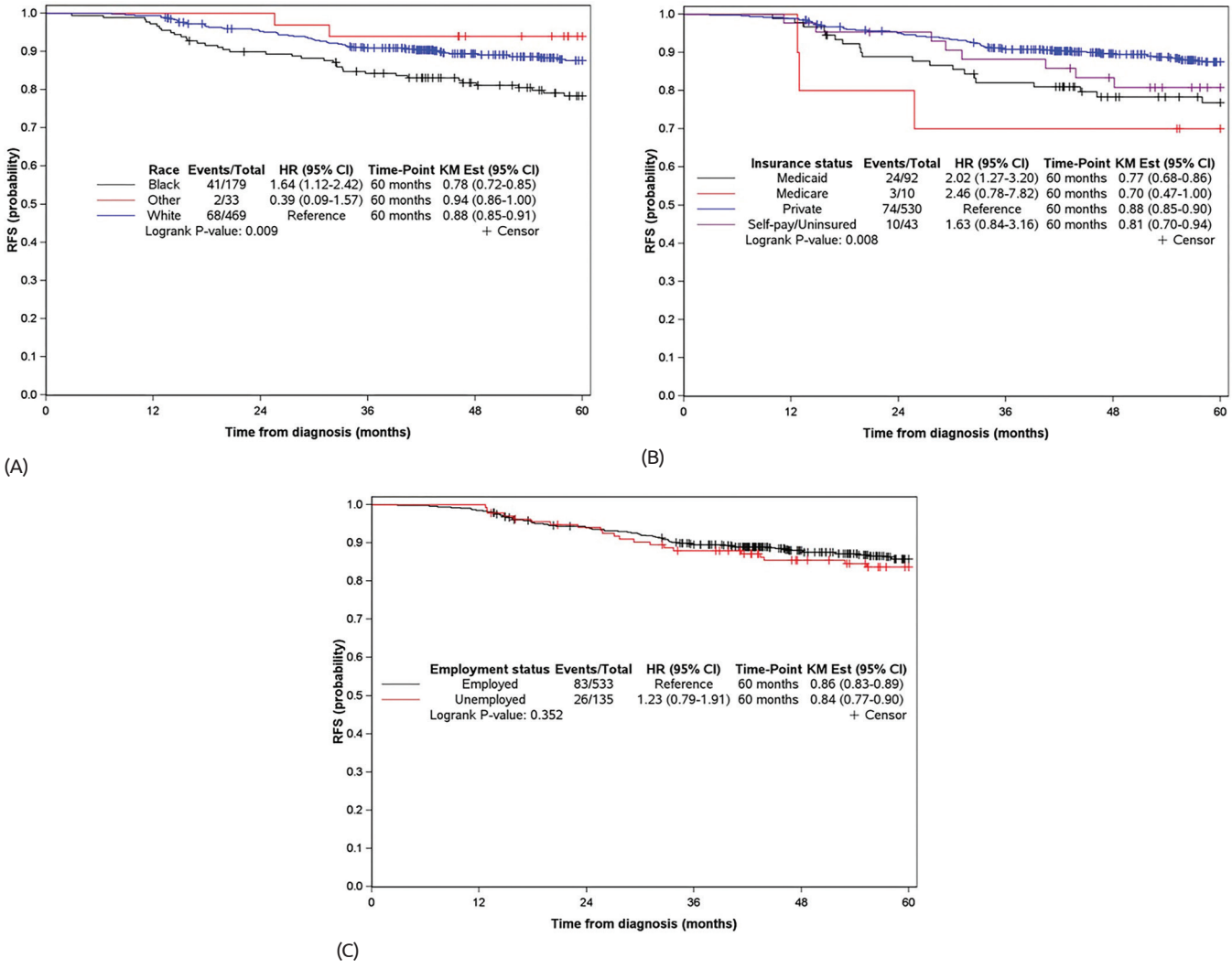

Figure 5. Kaplan-Meier curves of recurrence-free survival by race (A), insurance status (B), and employment status (C)

distinguishing race from ethnicity on intake forms. Despite extensive electronic medical record review, we were unable to accurately identify the ethnicity of these patients. This reflects a broader national challenge faced by many institutions (21-23). In our study, the small number of Hispanic participants and the high proportion of missing ethnicity data limited the interpretability of meaningful analyses of survival outcomes by ethnicity. We have used these findings to strengthen our current intake process by requiring that ethnicity be stated clearly. Unlike race and ethnicity, insurance and employment statuses can change throughout the patient's treatment course. Adjustments to these statuses were not routinely available in the database, with the captured data likely pertaining to the status at the time of diagnosis. Additionally, income and education levels were not captured in the database, and thus may have limited the analysis.

Continued research and emphasis on accurate, inclusive electronic medical record data collection are needed to better understand the effects of patient demographics on surgical approach and subsequent OS and RFS among young women with breast cancer. Hospital systems should prioritize standardized collection of patients' socioeconomic factors, including race, ethnicity, employment, transportation, literacy, education level, insurance, and income. Robust datasets including patients' socioeconomic and demographic factors, disease characteristics, and treatment modalities would provide further insight into the impact of social determinants of health on breast cancer outcomes.

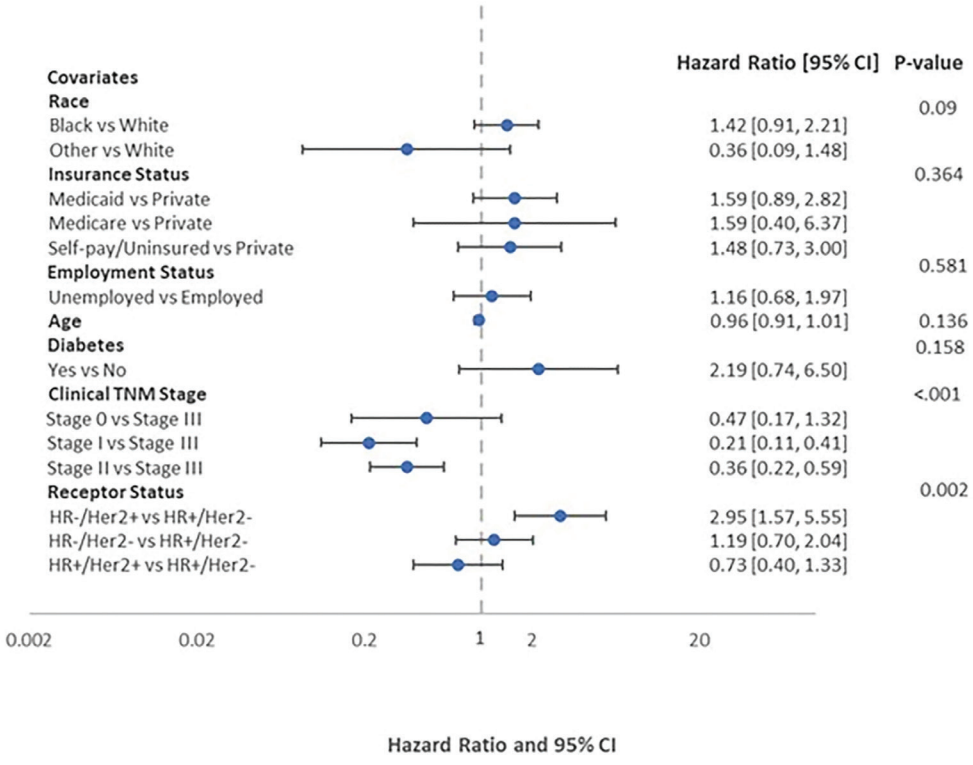

Figure 6. Forest plot depiction of the multivariable model of recurrence-free survival

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Ethics

Ethics Committee Approval: Not necessary.

Informed Consent: Not necessary.

Footnotes

Authorship Contributions

Surgical and Medical Practices: J.B., K.B., R.L.W., L.H-G.; Concept: L.H-G.; Design: R.L.W., L.H-G.; Data Collection or Processing: F.A., M.M.R., C.R.S.; Analysis or Interpretation: J.B., K.B., F.A., M.M.R., L.H-G.; Literature Search: J.B., K.B.; Writing: J.B., K.B., F.A., M.M.R., C.R.S., R.L.W., L.H-G.

Conflict of Interest: No conflict of interest was declared by the authors.

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