Increasing Trends in the Use of Breast-Conserving Surgery in California

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A B S T R A C T

Objectives. The purpose of this study was to determine temporal trends in breast-conserving surgery in California from 1988 through 1995.

Methods. Logistic regression was used to analyze data on 104 466 cases of early-stage breast cancer reported to the California Cancer Registry.

Results. A monotonically increasing trend in breast-conserving surgery was detected after adjustment for age, race/ethnicity, stage at diagnosis, and neighborhood education level. Breast-conserving surgery increased at similar rates among all racial/ethnic groups. Older age, Asian or Hispanic race/ethnicity, late-stage diagnosis, and residence in an undereducated neighborhood were factors associated with lower use of breast-conserving surgery.

Conclusions. Although disparities are evident, use of breast-conserving surgery increased steadily in all groups examined in this study. (*Am J Public Health*. 2000;90:281–284)

On the basis of results of retrospective studies and randomized clinical trials conducted during the 1980s, the 1990 National Institutes of Health Consensus Conference[1] recommended breast-conserving surgery as an appropriate therapy for most women with stage I and stage II breast cancer. This recommendation was reaffirmed in 1995 after the exclusion of questionable data from one of the key clinical trials on surgical treatment of breast cancer.[2]

Temporal trends in the use of breast-conserving surgery have been described for different geographic areas of the United States.[3–9] In recent years, steady increases in the use of such surgery have been reported. For example, one study showed that in the Detroit metropolitan area, the percentage of women with localized breast cancer who were undergoing breast-conserving surgery increased from 4% in the 1973 to 1977 period to 39% in the 1988 to 1992 period.[3] That study, however, included only White and Black women. A recent population-based study conducted in Connecticut reported annual increases of 14% to 19% in the rates of breast-conserving surgery for stage I and stage II breast cancers diagnosed from 1989 to 1994,[4] but race/ethnicity was not included as a variable in the analysis.

The unique diversity of the California population allowed us to assess potential differences in patterns of care for different racial/ethnic groups. This study used data from the California Cancer Registry to examine temporal trends in use of breast-conserving surgery in the treatment of women diagnosed with early-stage breast cancer in California from 1988 through 1995. Trends were analyzed by age, stage at diagnosis, and education level of immediate neighborhood for White, Black, Hispanic, and Asian/Pacific Island women.

Two main questions were addressed in this study: (1) Was there an increasing trend in the use of breast-conserving surgery in California during the study period? and (2) Despite differences in the use of breast-conserving surgery by race/ethnicity, age, stage at diagnosis, and neighborhood education level, is there evidence that use has increased at similar rates in all of these groups?

Methods

Study Population

This study included 104 466 women with early-stage breast cancer (first primary tumors only, histologically confirmed stage 0, I, or II) diagnosed in California from 1988 through 1995.The women had undergone either a mastectomy or breast-conserving surgery during their first course of treatment. Data were derived from the California Cancer Registry, which is considered to have complete statewide coverage; details on its operation and reporting regions have been published elsewhere.[10,11]

Definition of Variables

Surveillance, Epidemiology, and End Results program extent of disease codes were converted to the American Joint Committee on Cancer staging system.[12] Age at diagnosis was grouped to represent premenopausal women (0–49 years), postmenopausal women before eligibility for Medicare (50–64 years), and postmenopausal women after eligibility for Medicare (65 years and older).

Race/ethnicity was grouped into 4 mutually exclusive categories: Hispanic, non-Hispanic White, non-Hispanic Black, and non-Hispanic Asian/Pacific Islander. Hispanic ethnicity was determined by medical record or death certificate information and by surname. Women whose race was coded as White, Black, or unknown and whose last name (or maiden name, when present) was included on the 1980 US census list of 12 497 Hispanic surnames were categorized as Hispanic. Surnames were used to allow more accurate classification of Hispanic ethnicity, which is usually

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underreported in medical records and on death certificates.[13]

Block group data from the 1990 US census were used to represent the education level of the patient's neighborhood. A woman was considered to live in an undereducated neighborhood if 25% or more of adults 25 years and older in that particular block group had not completed high school.

Statistical Analysis

Logistic regression was used to model temporal trends in use of breast-conserving surgery over mastectomy, as measured by odds ratios (ORs) and 95% confidence intervals. Unadjusted odds ratios for use of breast-conserving surgery were estimated by year of diagnosis, race/ethnicity (Asian/Pacific Islander, Black, or Hispanic vs White), age at diagnosis (50–64 years or 65 years and above vs 0–49 years), stage at diagnosis (I or II vs 0), and education level of the patient's neighborhood (undereducated vs educated).

Multivariate models were constructed to estimate odds ratios of use of breast-conserving surgery after adjustment for all study variables. Year of diagnosis was coded as a series of dummy variables representing comparisons between adjacent years.[14] A monotonically increasing trend in use of breast-conserving surgery was considered to have occurred if all coefficients for the year-of-diagnosis variables were positive and statistically significant.[15]

As a means of examining whether temporal trends were similar at all age levels, year of diagnosis was entered into a model as a single continuous variable together with interaction terms involving dummy variables for age. Similar models were used to test for interactions of year of diagnosis with race, stage, and education after adjustment for all other variables. These models assessed whether the slopes of the trend lines for levels within a class were different from the slope for the reference level in that class (e.g., whether the annual trend for Asian/Pacific Island, Black, and Hispanic women differed from the trend for White women).

TABLE 1—Characteristics of the Study Population, and Breast-Conserving Surgery (BCS) as a Percentage of All Surgical Treatment: California, 1988–1995

Characteristic	No. (%)	BCS, %[a]
Race/ethnicity		
White	83 895 (80.3)	42.7
Black	5 221 (5.0)	43.3
Hispanic	9 685 (9.3)	37.1
Asian/Pacific Islander	5 665 (5.4)	32.5
Age at diagnosis, y		
0–49	23 995 (23.0)	45.0
50–64	31 619 (30.3)	43.0
65+	48 852 (46.8)	39.2
Education level in neighborhood[b]		
Educated	76 474 (73.2)	44.0
Undereducated	27 992 (26.8)	35.4
Stage at diagnosis[c]		
0	6 710 (6.4)	61.5
I	53 912 (51.6)	49.0
II	43 844 (42.0)	29.7
Year of diagnosis		
1988	11 618 (11.1)	27.9
1989	11 543 (11.1)	30.3
1990	12 338 (11.8)	34.7
1991	13 007 (12.5)	37.9
1992	13 727 (13.1)	43.1
1993	13 592 (13.0)	48.1
1994	14 009 (13.4)	51.8
1995	14 632 (14.0)	54.1
Total[d]	104 466 (100.0)	41.7

[a]Includes partial or segmental mastectomy, quadrantectomy, tylectomy, wedge resection, nipple resection, lumpectomy, and excisional biopsy with or without dissection of axillary lymph nodes.
[b]Based on the percentage of adults 25 years and older without a high school diploma (undereducated = ≥25%, educated = <25%).
[c]Stage 0: in situ tumors; stage I: tumors ≤2 cm without lymph node involvement; stage II: tumors ≤2 cm with positive lymph nodes or tumors 2.1 cm to 4 cm, regardless of nodal status. Tumors larger than 4 cm (the upper limit in most clinical trials) were excluded from the analysis.
[d]Cases reported only through autopsy or death certificate were excluded from the analysis. Also excluded were women who presented with any of the following conditions: microscopic tumor foci; mammography/xerography diagnosis only, with no tumor size given; diffuse tumors; or inflammatory carcinoma.

Results

Characteristics of the women included in the study are shown in Table 1. In 1988, 27.9% of women diagnosed with stage 0, I, or II breast cancer underwent breast-conserving surgery as part of their first course of treatment. In 1995, the percentage of women undergoing breast-conserving surgery increased to 54.1% ($P < .001$ for trend). After control for race/ethnicity, age, stage at diagnosis, and neighborhood education, logistic regression models with year of diagnosis coded as a comparison between adjacent years showed evidence of a significant monotonically increasing trend in use of breast-conserving surgery (Table 2).

Analyses detected a significant impact of neighborhood education on surgical treatment received. Women living in undereducated areas (OR = 0.75; CI = 0.73, 0.77) were less likely to undergo breast-conserving surgery than those living in educated areas.

Stage at diagnosis and age at diagnosis were also significant factors in the type of surgery received. Women diagnosed at earlier stages or at younger age levels were more likely to be treated with breast-conserving surgery. The adjusted odds ratios for undergoing breast-conserving surgery were 0.83 (CI = 0.80, 0.86) and 0.67 (CI = 0.65, 0.69), respectively, for women diagnosed between 50 and 64 years of age and those diagnosed at 65 years and older in comparison with women younger than 50 years at diagnosis. Likewise, women diagnosed with stage I (OR = 0.65; CI = 0.62, 0.68) or stage II (OR = 0.28; CI = 0.26, 0.29) breast cancer were significantly less likely than women diagnosed with in situ tumors to undergo breast-conserving surgery.

Significant differences in the odds of breast-conserving surgery were detected as well among the 4 racial/ethnic groups, and these differences persisted after adjustment for the other study variables. Both Hispanic (OR = 0.86; CI = 0.82, 0.90) and Asian/Pacific Island (OR = 0.57; CI = 0.54, 0.61) women were less likely to be treated with breast-conserving surgery than White women. Black women were the most likely to undergo

TABLE 2—Adjusted and Unadjusted Odds Ratios for Temporal Trends and Factors Associated With Use of Breast-Conserving Surgery: California, 1988–1995

	Unadjusted OR (95% CI)	Adjusted OR[a] (95% CI)
Race/ethnicity		
White	Reference	Reference
Black	1.02 (0.97, 1.08)	1.16 (1.09, 1.23)
Hispanic	0.79 (0.76, 0.83)	0.86 (0.82, 0.90)
Asian/Pacific Islander	0.64 (0.61, 0.68)	0.57 (0.54, 0.61)
Age at diagnosis, y		
0–49	Reference	Reference
50–64	0.92 (0.89, 0.95)	0.83 (0.80, 0.86)
65+	0.79 (0.76, 0.81)	0.67 (0.65, 0.69)
Education level in neighborhood[b]		
Educated	Reference	Reference
Undereducated	0.70 (0.68, 0.72)	0.75 (0.73, 0.77)
Stage at diagnosis[c]		
0	Reference	Reference
I	0.60 (0.57, 0.63)	0.65 (0.62, 0.68)
II	0.26 (0.25, 0.28)	0.28 (0.26, 0.29)
Year of diagnosis		
1988	Reference	Reference
1989 (vs 1988)	1.13 (1.06, 1.19)	1.12 (1.06, 1.19)
1990 (vs 1989)	1.22 (1.16, 1.29)	1.21 (1.14, 1.28)
1991 (vs 1990)	1.15 (1.09, 1.21)	1.13 (1.08, 1.20)
1992 (vs 1991)	1.24 (1.18, 1.30)	1.25 (1.19, 1.31)
1993 (vs 1992)	1.22 (1.17, 1.28)	1.23 (1.17, 1.29)
1994 (vs 1993)	1.16 (1.11, 1.22)	1.16 (1.10, 1.21)
1995 (vs 1994)	1.10 (1.05, 1.15)	1.12 (1.07, 1.17)

Note. Breast-conserving surgery includes partial or segmental mastectomy, quadrantectomy, tylectomy, wedge resection, nipple resection, lumpectomy, and excisional biopsy with or without dissection of axillary lymph nodes. OR = odds ratio; CI = confidence interval.

[a]Adjusted for all other variables included in the model.

[b]Based on the percentage of adults 25 years and older without a high school diploma (undereducated = ≥25%, educated = <25%).

[c]Stage 0: in situ tumors; stage I: tumors ≤2 cm without lymph node involvement; stage II: tumors ≤2 cm with positive lymph nodes or tumors 2.1 cm to 4 cm, regardless of nodal status. Tumors larger than 4 cm (the upper limit in most clinical trials) were excluded from the analysis.

breast-conserving surgery during the study period (OR = 1.16; CI = 1.09, 1.23).

Interaction terms between year of diagnosis (treated as a continuous variable) and race/ethnicity were subsequently added to the model to test whether the slopes for Black, Hispanic, and Asian/Pacific Island women significantly differed from the slope for White women. The addition of the interaction terms did not significantly improve the model ($P = .56$), and all 3 interaction term coefficients were nonsignificant (Table 3). Thus, there was no evidence that temporal trends during the 8-year period differed by race/ethnicity.

However, it appears that rates of breast-conserving surgery increased somewhat faster among women 50 years and older ($P < .001$ for the age and year interaction terms) and among women living in educated areas ($P = .048$). Increases were also slightly more pronounced for women diagnosed with stage I breast cancer ($P = .028$).

Discussion

The increasing linear trend detected in this study is consistent with reports from other areas of the United States.[3,4] The monotonic character of the trend suggests that in California, as in Connecticut,[4] negative publicity surrounding one of the key US clinical trials had little impact on the acceptance of breast-conserving surgery for early-stage breast cancer.

The impact of age and stage at diagnosis[3,8,16–18] and census-derived education level[8,19,20] on the choice of surgical treatment for breast cancer was also consistent with previous studies. As expected, age at diagnosis was a strong predictor of the type of surgery received; younger women were significantly more likely to undergo breast-conserving surgery. Other studies on use of breast-conserving surgery have incorporated education level in either the census tract[8] or zip code[19,20] of residence as a measure of socioeconomic status. In this study, education level in block group of residence was also associated with use of breast-conserving surgery; women living in undereducated areas were significantly less likely to undergo such surgery than those living in educated areas.

Although appropriate treatment for in situ carcinomas is still an area of controversy, results from this study show that breast-conserving surgery has been used widely for treatment of in situ breast cancers in California. In fact, the odds of undergoing breast-conserving surgery among women diagnosed with in situ tumors were 1.5 and 3.6 times higher than the odds among women diagnosed with stage I and stage II breast cancer, respectively.

Findings from previous studies on the association between type of surgery and race/ethnicity have not been consistent. In one of these studies, White and Black women were equally likely to be treated with breast-conserving surgery after adjustment for socioeconomic status and urban/rural residence.[19] Race was also not a significant predictor of use of breast-conserving surgery in a study that adjusted for tumor size and comorbidities.[21] In a contrasting study involving Medicare data, Black women were 20% less likely to undergo breast-conserving surgery than women of all other races after adjustment for nodal status and hospital characteristics.[22]

In the present study, the large number of cases and the diversity of the California population enabled us to delineate marked differences in surgical treatment among the racial/ethnic groups examined. The odds of undergoing breast-conserving surgery among Hispanic and Asian/Pacific Island women in California were substantially lower than the odds among White and Black women. Consistent with a previous study involving a sample of US hospitals from 1981 to 1987,[23] the odds of breast-conserving surgery were 16% higher for Black than for White women.

Despite the differences just highlighted, use of breast-conserving surgery in California increased steadily among all racial/ethnic groups, age groups, stages at diagnosis, and education levels examined in this study. The rate of increase in use of breast-conserving surgery was slightly higher among women 50 years and older, among women diagnosed with stage I breast cancer, and among women living in more educated neighborhoods. No significant differences in breast-conserving surgery trends were detected by race/ethnicity.

Although most women with stage I and stage II breast cancer are good candidates for breast-conserving surgery, the optimal pro-

TABLE 3—Differences in Temporal Trends in Breast-Conserving Surgery, by Race/Ethnicity, Stage at Diagnosis, Age at Diagnosis, and Neighborhood Education: California, 1988–1995

Model	Slope (Log Odds) of Linear Trend[a]	*P* for Slope[b]	Interaction *P*[c]
Race/ethnicity			.562
White (referent)	0.169	<.001	
Black	0.160	.520	
Hispanic	0.175	.578	
Asian/Pacific Islander	0.153	.264	
Age at diagnosis, y			<.001
0–49 (referent)	0.142	<.001	
50–64	0.176	<.001	
65+	0.176	<.001	
Education level in neighborhood[d]			.048
Educated (referent)	0.172	<.001	
Undereducated	0.158	.048	
Stage at diagnosis[e]			.003
0 (referent)	0.150	<.001	
I	0.177	.028	
II	0.159	.498	

Note. Breast-conserving surgery includes partial or segmental mastectomy, quadrantectomy, tylectomy, wedge resection, nipple resection, lumpectomy, and excisional biopsy with or without dissection of axillary lymph nodes. Each model was adjusted for all other variables.
[a]Slope of time trend in log odds of use of breast-conserving surgery.
[b]*P* value for reference category reflects difference of slope from zero. *P* values for other categories reflect difference from reference category slope.
[c]*P* value for global test of interaction reflects differences in time trends among groups.
[d]Based on the percentage of adults 25 years and older without a high school diploma (undereducated = ≥25%, educated = <25%).
[e]Stage 0: in situ tumors; stage I: tumors ≤2 cm without lymph node involvement; stage II: tumors ≤2 cm with positive lymph nodes or tumors 2.1 cm to 4 cm, regardless of nodal status. Tumors larger than 4 cm (the upper limit in most clinical trials) were excluded from the analysis.

portion of women treated with this surgery remains unresolved. Clearly, a number of nonclinical decisions are factors in the complex choice of surgical treatment. For many women, fear of recurrence and hardship of radiotherapy may outweigh the benefits of breast conservation. Nonetheless, the increasing trend toward use of breast-conserving surgery in California and in other parts of the United States is an indication that this important advance in the treatment of breast cancer is progressively gaining acceptance. □

Contributors

C. R. Morris planned the study, performed the data analysis, and wrote the manuscript. R. Cohen assisted with the statistical analysis and interpretation of the results. R. Schlag and W. E. Wright contributed to the conception of the study and participated in writing the final manuscript.

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