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Sacramento Area Breast Cancer Epidemiology Study (SABES): Use of Post-Mastectomy Breast Reconstruction Along the Rural to Urban Continuum

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Abstract

Background—Health care disparities have been documented in rural populations. We hypothesized that breast cancer (BCa) patients in urban counties would have higher rates of post-mastectomy breast reconstruction (BR) relative to patients in surrounding near-metro and rural counties.

Methods—We used the Surveillance, Epidemiology, and End Results (SEER) database to identify patients diagnosed with BCa and treated with mastectomy in the greater Sacramento area between 2000 and 2006. Counties were categorized as urban, near-metro or rural. Univariate models evaluated the relationship of rural, near-metro or urban location with use of BR via the chi-square test. Multivariate logistic regression models controlling for patient, tumor, and treatment-related factors predicted use of BR. The likelihood of undergoing BR was reported as odds ratios (OR) with 95% confidence intervals (CI); significance was set at $p \leq 0.05$.

Results—Complete information was available for 3,552 BCa patients treated with mastectomy. Of these, 718 (20.2%) underwent BR. On univariate analysis, differences in the rates of BR were noted among urban, near-metro and rural areas ($p<0.001$). On multivariate analysis patients from rural (OR 0.51, CI 0.28-0.93; $p<0.03$) and near-metro (OR 0.73, CI 0.59-0.89; $p=0.002$) areas had a decreased likelihood of undergoing BR relative to patients from urban areas.

Conclusions—Patients from near-metro and rural areas as less likely to receive BR following mastectomy for BCa than their urban counterparts. Differences in use of BR detected at a population level should guide future interventions to increase rates of BR at the local level.

Introduction

Because breast reconstruction (BR) has a significant positive psychosocial impact on patients[1-4], it is increasingly seen as a necessary and integral component of post-mastectomy breast cancer (BCa) therapy[5]. Although patients with BCa who reside in rural areas are 58% more likely than their urban counterparts to receive mastectomy, [6] little is known about their

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utilization of BR. From the management of chronic disease to the diagnosis and treatment of malignancies, patients living in rural areas are less likely to receive standard care and more likely to have poorer survival than those living in urban areas[7-11] We therefore hypothesized that BCa patients in urban counties of Northern California would have higher rates of post-mastectomy BR relative to patients in surrounding near-metro and rural counties.

Methods

We used the Surveillance, Epidemiology, and End Results (SEER) database to identify patients diagnosed with infiltrating ductal carcinoma (IDC), infiltrating lobular carcinoma (ILC), or mixed infiltrating ductal and lobular carcinoma (MDLC) of the breast treated with mastectomy in the greater Sacramento area between 2000 and 2006. The Surveillance Epidemiology and End Results (SEER) database of the National Cancer Institute was used to identify patients undergoing mastectomy for IDC, ILC, or MDLC from 1988 to 2006. The registries, attributes, and limitations of the SEER database have been reported previously[12-16].

All cases of primary, histologically confirmed, IDC, ILC, or MDLC were eligible. Patients with metastatic disease, and those identified by death certificate or autopsy were excluded. The final sample included 7,207 patients. Fourteen counties, including Sacramento County, were assessed for this study. We used the 2003 rural-urban continuum codes for California from the United States Department of Agriculture (USDA) to make decisions regarding whether a county was to be considered rural, near-metro, or urban (http://www.usda.gov/wps/portal/usdahome).

The USDA assigns counties a code number from 1 to 9, indicating progressive rurality. Counties coded as "1" (El Dorado, Placer, Sacramento, and Yolo Counties) were considered urban. Counties coded as "2, 3, 4, or 5" (Butte, Nevada, San Joaquin, Stanislaus, Sutter, and Yuba Counties) were considered near-metro. Counties coded as "6, 7, 8, or 9" (Alpine, Amador, Calaveras, and Colusa Counties) were considered rural.

Univariate models evaluated the relationship of rural, near-metro or urban location with use of BR via the chi-square test. Covariates assessed included patient age (median split, ≤ 62 years vs. ≥ 63 years), sex, race/ethnicity (Asian/Pacific Islander, black, Hispanic, native American, White), American Joint Committee on Cancer (AJCC) T stage, AJCC N stage, tumor grade, hormone receptor status (positive, negative, equivocal, unknown), tumor histology (IDC, ILC, MDLC), type of mastectomy (unilateral vs. bilateral) and use of radiation therapy (yes, no, unknown).

We used multivariate logistic regression models to assess the role of rural, near-metro, or urban status on the likelihood of receiving BR while controlling for all factors assessed in the univariate analysis, except sex. Age was assessed as a continuous variable in the multivariate analyses. Patients for whom BR status was unknown were excluded, leaving 3,552 patients for analysis. For categorical and ordinal variables, the most prevalent or clinically relevant variable served as the referent group. Additional multivariate logistic regression models were constructed to assess the likelihood of receiving BR for each county relative to Sacramento County. Likelihood of undergoing BR was reported as odds ratios (OR) with 95% confidence intervals (CI); significance was set at $p \leq 0.05$.

Results

Patient, tumor, and treatment-specific characteristics of the study population are presented in Table 1. The total population of patients included 7,207 BCa patients treated with mastectomy. Briefly, the median age of patients was 62 years. Men represented 1% of the

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study population. The majority of patients were white (80.6%). As expected, most patients were from urban (58.7%) or near-metro (37.8%) counties; only 3.4% were from rural counties. T1 and T2 tumors represented 87.3% of primary tumors. Lymph node metastases were reported in 42.1% of patients. Grade was low (I/II) in 58.8% and high (III/IV) in 32.3% of patients. Tumor histology was IDC, ILC and MDLC in 78.2%, 11.1%, and 10.8% of patients, respectively. The majority of tumors were estrogen receptor (68.2%) and progesterone receptor (56.6%) positive. Unilateral mastectomies (97.9%) were more common than bilateral mastectomies (2.1%). The majority of patients (79%) did not receive adjuvant radiation therapy. Ten percent of all study patients underwent BR, while 39.3% did not. It was unknown whether or not a patient had BR in 50.7% of cases.

Differences among the study population were further examined according to whether patients were from rural, near-metro, or urban counties (Table 2). Significant differences were noted among rural, near-metro, and urban patients with respect to race/ethnicity ($P<0.001$), tumor grade ($P=0.003$), histology ($P<0.001$), estrogen receptor status ($P=0.001$), progesterone receptor status ($P<0.001$), use of breast reconstruction ($P<0.001$) and use of radiation therapy ($P=0.021$).

Two multivariate models were constructed. The first model (Model A) assessed the varying categories of counties (rural, near-metro, urban) by the use of BR while the second model (Model B) did not categorize according to county type but rather included each county separately to assess the likelihood of receiving BR.

Model A is summarized in Table 3. When compared to patients from urban counties, those from rural (OR 0.73, CI 0.59-0.89; $P=0.002$) and near-metro counties (OR 0.51, CI 0.28-0.93; $P=0.028$) demonstrated a decreased likelihood of receiving BR. Additional factors predicting a decreased likelihood of BR included increasing age (OR 0.92, CI 0.91-0.92; $p<0.001$), Asian race (OR 0.42, CI 0.27-0.67; $p<0.001$), black race (OR 0.55, CI 0.31-0.98; $p=0.043$), Hispanic ethnicity (OR 0.67, CI 0.46-0.97; $p=0.032$), N2 (OR 0.55, CI 0.37-0.82; $p=0.003$), N3 (OR 0.16, CI 0.07-0.35; $p<0.001$) and NX (OR 0.57, CI 0.34-0.97; $p=0.038$) status, unknown tumor grade (OR 0.61, CI 0.40-0.93; $p=0.021$), and use of radiation therapy (OR 0.39, CI 0.29-0.53; $p<0.001$, Table 3). The only factors predicting an increased likelihood of BR were receipt of bilateral mastectomy surgery (OR 3.45, CI 2.10-5.66; $p<0.001$), ILC histology (OR 1.75, CI 1.25-2.45; $p=0.001$), and T4 tumors (OR 35.23, CI 3.24-383.18; $p=0.003$).

Model B is summarized in Table 4. When compared to Sacramento County, the following counties were associated with a decreased likelihood of receiving BR: Amador (OR 0.36, CI 0.14-0.90; $p=0.03$), Butte (OR 0.24, CI 0.12-0.49; $p<0.001$), San Joaquin (OR 0.62, CI 0.45-0.85; $p=0.003$), and Stanislaus (OR 0.53, CI 0.37-0.76; $p=0.001$) counties. Nevada County was the only county associated with an increased likelihood (OR 2.25, CI 1.46-3.48; $p<0.001$) of receiving BR. The only other factors predicting an increased likelihood of BR were receipt of bilateral mastectomy surgery (OR 3.39, CI 2.05-5.60; $p<0.001$), ILC histology (OR 1.70, CI 1.21-2.38; $p=0.002$), and T4 tumors (OR 52.33, CI 4.41-620.49; $p=0.002$). Additional factors predicting a decreased likelihood of receiving BR were increasing age (OR 0.91, CI 0.91-0.92; $p<0.001$), Asian race (0.42, CI 0.26-0.67; $p<0.001$), black race (OR 0.53, CI 0.29-0.94; $p=0.029$), N2 (OR 0.53, CI 0.35-0.79; $p=0.002$), N3 (OR 0.15, CI 0.07-0.34; $p<0.001$) and NX (OR 0.58, CI 0.34-0.99; $p=0.046$) status, and unknown tumor grade (OR 0.65, CI 0.43-0.99; $p=0.046$).

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Discussion

Nationally, approximately 5.6-42% of women undergoing mastectomy receive immediate or early- delayed BR[17-20]. BR has been shown to have a significant positive psychosocial impact on patients[1-4] with overall good to excellent patient satisfaction[3, 21-22]. Appropriately, the Women's Health and Cancer Rights Act of 1998 requires all medical insurers providing mastectomy coverage to also cover all stages of reconstruction of the affected breast and reconstruction of the contralateral breast to provide a symmetrical appearance[23]. Because post-mastectomy BR has become an expected component of quality cancer care, because residents of rural areas have demonstrated health care disparities relative to their urban-dwelling counterparts for other health indicators, and because rural residents have been shown to more likely undergo mastectomy for the primary treatment of their BCa, we hypothesized that patients from more rural areas would be less likely to receive post-mastectomy BR than their urban counterparts.

In agreement with our stated hypothesis, patients from rural and near-metro areas were less likely to receive post-mastectomy BR relative to their urban-dwelling counterparts, even after controlling for known patient, tumor, and treatment-specific factors. The reason for the observed rural-urban disparity in usage of BR is unclear, but is likely multifactorial. In addition to demonstrating the BR disparities among rural, near-metro, and urban counties, the present study validates previously reported predictors of lower likelihood of BR including age[24], ethnicity[18, 25], removal of the contralateral breast[2], tumor factors predictive of local recurrence including T stage[2, 26-27], and tumor grade[28]. The only factors associated with an increased likelihood of BR in our study included performance of a bilateral mastectomy procedure, ILC histology, and T4 tumors. Patients undergoing bilateral mastectomy for prophylactic reasons may be more motivated to undergo BR to obtain chest wall symmetry and simultaneously reduce their risk of contralateral breast cancer. Similarly, ILC more often is bilateral than IDC and these patients may therefore more likely choose or require bilateral mastectomy for treatment of their breast cancer. It seems counterintuitive that T4 tumors would be more associated with BR than smaller tumors. However, T4 tumors may necessitate more radical resections of the chest wall, which may require subsequent reconstruction for wound closure. These procedures may therefore be coded as BR procedures.

Why should rural patients receive lower rates of BR than urban patients? One possibility is that rural and near-metro areas may have fewer plastic surgeons. To investigate this possibility, we researched the number of plastic surgeons within each county using the American Society of Plastic Surgery database. Those counties identified as "rural" had no plastic surgeons serving their areas. The counties identified as near-metro had a total of 20 plastic surgeons serving their areas. Urban counties, however, had 25 plastic surgeons servicing their areas. This would indicate that the supply of plastic surgeons in rural and near-metro areas may contribute to the lower rate of BR seen in these populations.

Patients from rural or near-metro areas may attempt to alleviate this plastic surgeons supply problem by traveling to an area where a plastic surgeon is available. Travel itself, however, may be an issue. Research has investigated the role of distance to travel for care as a predictor of compliance and receipt of obstetric, medical, and cancer care[29-35]. Athas et al., in their analysis of New Mexican women undergoing care for BCa, found an inverse relationship between travel distance and receipt of post lumpectomy radiation therapy[36]. Nair et al. evaluated the effect of travel distance on bilateral breast reduction utilization among symptomatic women living near Edinburgh, Scotland. The Scottish health care system is socialized and provides free health care to all permanent residents, and breast reduction is fully covered for eligible women. They found that the likelihood of uptake of

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breast reduction surgery decreased with both travel time and distance traveled to the operative hospital. In this study, satellite plastic surgery clinics that assessed women preoperatively and that were strategically located within rural communities had a strong positive effect on qualified, symptomatic women receiving breast reduction[37]. Difficulty in attaining plastic surgeon consultation and travel barriers may negatively influence surgeon-patient discussions of and patient decisions about BR.

Finding a plastic surgeon, either locally or via distant travel, does not guarantee access to BR. Surgeon preference is cited as an important predictor of BCa treatment[38-40]. Higher BR rates are seen in patients who have pre-mastectomy discussions of BR with their cancer surgeon[41-42] and plastic surgeon[43]. Surgeons most likely to refer patients for BR are more likely women (OR 2.3, p=0.03), with high volume breast practices (OR 4.1, p=0.01), in cancer centers (OR 2.4, p=0.01)[44]. Surgeons least likely to refer patients for BR may believe that their patients have more barriers (cost, plastic surgeon availability) and lower desire for BR[44]. Although these studies were accomplished in exclusively urban areas, these findings raise the question of whether or not similar referral patterns and biases exist among surgeons practicing in rural areas. It is possible that rural surgeons may be less likely to have discussions regarding BR with their patients and be less likely to recommend BR. These biases could contribute to the BR rate disparities seen in the current study and should be a point of future research.

Race/ethnicity can influence rates of BR. Using the SEER registries from Detroit and Los Angeles, Alderman et al. showed that 40.9% of whites received BR while 33.5% of blacks received post mastectomy BR[25]. Interestingly, assimilated Hispanics showed rates of BR of 41.2%, while un-assimilated Hispanics had BR rates of only 13.5%. The authors further showed that non-white women were less likely than white women to see a plastic surgeon before initial surgery but were more likely to desire information regarding BR. Our data confirm the role of race/ethnicity on use of BR; black and Hispanic women had a 45% and 33% decreased likelihood, respectively, of receiving BR relative to white women. Even with the incorporation of race/ethnicity into several multivariate analyses, rural areas continued to show lower rates of BR relative to urban areas.

Patient income[17] and insurance status[20] may also influence receipt of BR. Christian et al. demonstrated a 42% rate of BR within 8 National Comprehensive Cancer Network Centers —a rate significantly higher than previously reported in population-based studies[45]--and found that patients with Medicare/ Medicaid were significantly less likely to receive BR than those with managed care insurance. Even among a fully insured patient population, insurance status represents an important barrier to health care, and there are others[17]. A major reason patients express for not undergoing BR is a desire for no further surgery[27, 38]. Unfortunately, our SEER data do not allow us to comment on individual patient income, insurance status, or preferences.

Nevada county was the only geographic area to demonstrate an association with a higher likelihood of BR as compared to Sacramento county (OR 2.25, 95% CI 1.46-3.48, P<0.001). Sixty miles from the city of Sacramento, California and 88 miles from the city of Reno, Nevada, median household income in Nevada County was $52,700 (2000, 3rd highest among the counties examined-data not shown[46]) as compared to a median household income of $50,700 for Sacramento County. The percentage of persons living under the poverty line in the county was 8.1% (3rd lowest among the counties examined). In contrast, residents in Butte County demonstrated the lowest likelihood of receiving BR (OR 0.24, 95% CI 0.12-0.49, p<0.001). Median household income was $41,000, and nearly 20% of the county lived below the poverty line. Residents of Amador County had the 2nd lowest likelihood of receiving BR (OR 0.36, 95% CI 0.14-0.90, p=0.03). Median household income of the

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county was $51,200 (4th highest) with 9.2% of the county populace living below the poverty line. These findings suggest that socioeconomic status is not the only population variable affecting delivery of post-mastectomy BR.

Limitations of this study include the fact that SEER codes only treatment received during the “first course” of therapy. We may have underestimated the number of patients receiving BR. It was unknown if 50.7% of patients in our series received BR. Furthermore, we determined that 18% of patients received post-mastectomy radiation therapy, presumably due to locally advanced disease. It is plausible, then, that those patients receiving late or delayed reconstruction due to intervening chest wall radiation therapy are not included in our analysis[47]. SEER also does not abstract medical comorbidities. It is possible that women with BCa from rural areas had a higher prevalence of significant relative contraindications to breast reconstruction such as smoking and diabetes. We also recognize that there is likely geographic clustering at the county and local level. Population based analyses such as these are not meant to be generalizeable at the individual level.

The decision to undergo BR is a personal decision. Those who decide to undergo BR report excellent rates of satisfaction and may receive psychological and social benefits from their decision. So, too, may women who make the informed choice not to perform BR. It is important to note, that patients may choose not to have BR because they do not feel it is necessary for their physical or emotional well-being[48].

Our findings generate a number of questions. In addition to the complex interaction between ethnicity and socioeconomic characteristics such as income, educational level, and employment status there likely exists an interaction between the rural- urban continuum and these factors. Even after controlling for previously investigated prognostic factors for BR, differences in BR rates among the counties studied existed.

Differences in use of BR detected at a population level should guide future studies and interventions to increase rates of BR at the local level. Findings from the current study suggest differences in the utilization of BR in rural and urban settings in Northern California. Further studies are needed to evaluate the causes of these disparities and identify potential areas of improvement with a goal of providing patient- centered BCa care.

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Table 1

Patient, tumor and treatment-specific characteristics of the study population.

Variable		**N (%)**
Age (median = 62 years)		
	≤ 62 years	3,733 (51.8)
	≥ 63 years	3,474 (48.2)
Sex		
	Male	72 (1.0)
	Female	7,135 (99)
Race/Ethnicity		
	Asian	462 (6.4)
	Black	270 (3.6)
	Hispanic	599 (8.3)
	Native American	28 (0.4)
	White	5,807 (80.6)
	Unknown	41 (0.6)
County Category		
	Rural	248 (3.4)
	Near-Metro	2,726 (37.8)
	Urban	4,233 (58.7)
T stage		
	T0	3 (0.1)
	T1	3,763 (52.2)
	T2	2,535 (35.1)
	T3	501 (7)
	T4	160 (2.2)
	TX	245 (3.4)
N Stage		
	N0	3,930 (54.5)
	N1	1,892 (26.3)
	N2	771 (10.7)
	N3	369 (5.1)
	NX	245 (3.4)
Tumor Grade		
	I	1,352 (18.7)
	II	2,890 (40.1)
	III	2,217 (30.8)
	IV	107 (1.5)
	Unknown	641 (8.9)
Histology		

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Variable		**N (%)**
	IDC	5,632 (78.2)
	ILC	798 (11.1)
	MDLC	777 (10.8)
Estrogen Receptor Status		
	Positive	4,918 (68.2)
	Negative	1,402 (19.5)
	Equivocal	21 (0.3)
	Unknown	866 (12.0)
Progesterone Receptor Status		
	Positive	4,078 (56.6)
	Negative	2,160 (30.0)
	Equivocal	86 (1.2)
	Unknown	883 (12.3)
Mastectomy		
	Unilateral	7,055 (97.9)
	Bilateral	152 (2.1)
Breast Reconstruction		
	Yes	718 (10.0)
	No	2,834 (39.3)
	Unknown	3,655 (50.7)
Radiation		
	Yes	1,296 (18.0)
	No	5,693 (79.0)
	Unknown	218 (3.0)

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Table 2

Patient, tumor, and treatment-related characteristics of the study population according to county status along the rural-urban continuum.

Variable		**Rural (N = 248)**	**Near-Metro (N = 2,726)**	**Urban (N = 4,233)**	**P-Value**
Age (median = 62 years)					
	≤ 62 years	119 (48%)	1,375 (50.4%)	2,239 (53%)	P=0.064
	≥ 63 years	129 (52%)	1,351 (49.6%)	1,994 (47.1%)	
Sex					
	Male	3 (1.1%)	31 (1.1%)	38 (0.9%)	P=0.584
	Female	245 (98.8%)	2,695 (98.9%)	4,195 (99.1%)	
Race/Ethnicity					
	Asian	1 (0.4%)	156 (5.7%)	305 (7.2%)	P<0.001
	Black	3 (1.2%)	77 (2.8%)	190 (4.5%)	
	Hispanic	25 (10.1%)	282 (10.3%)	292 (6.9%)	
	Native American	0 (0%)	16 (0.6 %)	12 (0.3%)	
	White	219 (88.3%)	2,167 (79.5 %)	3,421 (80.8%)	
	Unknown	0 (0%)	28 (1%)	13 (0.3%)	
T stage					
	T0	0 (0%)	2 (0.1%)	1 (0.0%)	P<0.07
	T1	135 (54.4%)	1,397 (51.3%)	2,231 (52.7%)	
	T2	71 (28.6%)	955 (35%)	1,509 (35.7%)	
	T3	23 (9.3%)	207 (7.6%)	271 (6.4%)	
	T4	7 (2.8%)	73 (2.7%)	80 (1.9%)	
	TX	12 (4.8%)	92 (3.4%)	141 (3.3%)	
N Stage					
	N0	132 (53.2%)	1,502 (55.1%)	2,296 (54.2%)	P=0.14
	N1	63 (25.4%)	678 (24.9%)	1,151 (27.2%)	
	N2	31 (12.5%)	282 (10.3%)	458 (10.8%)	
	N3	13 (5.2%)	158 (5.8%)	198 (4.7%)	
	NX	9 (3.6%)	106 (3.9%)	130 (3.1%)	
Tumor Grade					

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Variable		**Rural (N = 248)**	**Near-Metro (N = 2,726)**	**Urban (N = 4,233)**	**P-Value**
	I	40 (16.1%)	531 (19.5%)	781 (18.5%)	P=0.003
	II	112 (45.2%)	1,108 (40.7%)	1,670 (39.5%)	
	III	57 (23%)	833 (30.6%)	1,327 (31.4%)	
	IV	8 (3.2%)	30 (1.1%)	69 (1.6%)	
	Unknown	31 (12.5%)	224 (8.2%)	386 (9.1%)	
Histology					
	IDC	185 (74.6%)	2,240 (82.2%)	3,207 (75.8%)	P<0.001
	ILC	44 (17.7%)	272 (10%)	482 (11.4%)	
	MDLC	19 (7.7%)	214 (7.9%)	544 (12.9%)	
Estrogen Receptor Status					
	Positive	176 (71%)	1,811 (66.4%)	2,931 (69.2%)	P=0.001
	Negative	45 (18.2%)	540 (19.8%)	817 (19.3%)	
	Equivocal	0 (0%)	2 (0.1%)	19 (0.3%)	
	Unknown	27 (10.9%)	373 (13.7%)	466 (11%)	
Progesterone Receptor Status					
	Positive	146 (58.9%)	1,485 (54.5%)	2,447 (57.8%)	P<0.001
	Negative	74 (29.8%)	841 (30.9%)	1,245 (29.4%)	
	Equivocal	0 (0%)	19 (0.7%)	67 (1.6%)	
	Unknown	28 (11.3%)	381 (14%)	474 (11.2%)	
Mastectomy					
	Unilateral	244 (98.4%)	2,666 (97.8%)	4,145 (97.9%)	P=0.808
	Bilateral	4 (1.6%)	60 (2.2%)	88 (2.1%)	
Breast Reconstruction					
	Yes	15 (6.1%)	212 (7.8%)	491 (11.6%)	P<0.001
	No	106 (42.7%)	1,067 (39.1%)	1,661 (39.2%)	
	Unknown	127 (51.2%)	1,447 (53.1%)	2,081 (49.2%)	
Radiation					
	Yes	39 (15.7%)	448 (16.4%)	809 (19.1%)	P=0.021
	No	201 (81.1%)	2,183 (80.1%)	3,309 (78.2%)	

Variable		Rural (N = 248)	Near-Metro (N = 2,726)	Urban (N = 4,233)	P-Value
	Unknown	8 (3.2%)	95 (3.5%)	115 (2.7%)	

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Table 3

Multivariate logistic regression model of the entire study population predicting the likelihood of receiving breast reconstruction.

Variable		Odds Ratio	95% Confidence Interval	P-Value
Age		0.92	0.91-0.92	<0.000
Race/Ethnicity				
	White (referent)	***	***	***
	Asian	0.42	0.27-0.67	<0.000
	Black	0.55	0.31-0.98	=0.043
	Hispanic	0.67	0.46-0.97	=0.032
	Native American	2.66	0.73-9.60	=0.136
	Unknown	0.44	0.09-2.15	=0.313
T stage				
	T1 (referent)	***	***	***
	T0	10.98	0.65-185.52	=0.097
	T2	0.89	0.72-1.11	=0.313
	T3	0.81	0.52-1.27	=0.363
	T4	35.23	3.24-383.18	=0.003
	TX	0.70	0.41-1.20	=0.197
N Stage				
	N0 (referent)	***	***	***
	N1	0.83	0.66-1.04	=0.099
	N2	0.55	0.37-0.82	=0.003
	N3	0.16	0.07-0.35	<0.001
	NX	0.57	0.34-0.97	=0.038
Tumor Grade				
	I (referent)	***	***	***
	II	1.02	0.79-1.31	=0.905
	III	0.92	0.68-1.25	=0.59
	IV	1.52	0.74-3.11	=0.252
	Unknown	0.61	0.40-0.93	=0.021
Histology				
	IDC (referent)	***	***	***
	ILC	1.75	1.25-2.45	=0.001
	MDLC	1.23	0.92-1.65	=0.155
Estrogen Receptor Status				
	Positive (referent)	***	***	***
	Negative	0.77	0.55-1.08	=0.138
	Equivocal	3.17	0.73-13.68	=0.122
	Unknown	0.37	0.09-1.51	=0.164

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Variable		Odds Ratio	95% Confidence Interval	P-Value
Progesterone Receptor Status				
	Positive (referent)	***	***	***
	Negative	1.05	0.79-1.38	=0.756
	Equivocal	0.88	0.38-2.03	0.757
	Unknown	3.09	0.77-12.46	0.113
Mastectomy				
	Unilateral (referent)	***	***	***
	Bilateral	3.45	2.10-5.66	<0.001
Radiation				
	No (referent)	***	***	***
	Yes	0.39	0.29-0.53	<0.001
	Unknown	0.86	0.49-1.51	=0.594
County Status				
	Urban (referent)	***	***	***
	Rural	0.73	0.59-0.89	=0.002
	Near-Metro	0.51	0.28-0.93	=0.028

*** Referent population

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Table 4

Multivariate logistic regression model of the entire study population to assess the likelihood of receiving breast reconstruction for each county relative to Sacramento County.

Variable		**Odds Ratio**	**95% Confidence Interval**	**P-Value**
Age		0.91	0.91-0.92	<0.001
Race/Ethnicity				
	White (referent)	***	***	***
	Asian	0.42	0.26-0.67	<0.001
	Black	0.53	0.29-0.94	=0.029
	Hispanic	0.70	0.49-1.02	=0.065
	Native American	2.41	0.65-8.89	=0.186
	Unknown	0.49	0.10-2.41	=0.378
T stage				
	T1 (referent)	***	***	***
	T0	17.55	0.71-431.22	=0.079
	T2	0.93	0.74-1.16	=0.511
	T3	0.81	0.52-1.26	=0.342
	T4	52.33	4.41-620.49	=0.002
	TX	0.73	0.42-1.26	=0.261
N Stage				
	N0 (referent)	***	***	***
	N1	0.80	0.64-1.01	=0.062
	N2	0.53	0.35-0.79	=0.002
	N3	0.15	0.07-0.34	<0.001
	NX	0.58	0.34-0.99	=0.046
Tumor Grade				
	I (referent)	***	***	***
	II	0.97	0.75-1.26	=0.807
	III	0.87	0.64-1.18	=0.373
	IV	1.36	0.65-2.85	=0.412
	Unknown	0.65	0.43-0.99	=0.046
Histology				
	IDC (referent)	***	***	***
	ILC	1.70	1.21-2.38	=0.002
	MDLC	1.19	0.89-1.60	=0.235
Estrogen Receptor Status				
	Positive (referent)	***	***	***
	Negative	0.33	0.08-1.35	=0.124
	Equivocal	3.09	0.69-13.84	=0.139
	Unknown	0.33	0.08-1.35	=0.124

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Variable		**Odds Ratio**	**95% Confidence Interval**	**P-Value**
Progesterone Receptor Status				
	Positive (referent)	***	***	***
	Negative	1.07	0.81-1.42	=0.641
	Equivocal	0.88	0.38-2.05	0.770
	Unknown	3.31	0.83-13.25	0.091
Mastectomy				
	Unilateral (referent)	***	***	***
	Bilateral	3.39	2.05-5.60	<0.001
Radiation				
	No (referent)	***	***	***
	Yes	0.40	0.29-0.54	<0.001
	Unknown	0.89	0.50-1.59	=0.684
County				
	Sacramento (referent)	***	***	***
	Alpine	###	###	###
	Amador	0.36	0.14-0.90	=0.03
	Butte	0.24	0.12-0.49	<0.001
	Calaveras	0.85	0.36-1.99	=0.706
	Colusa	0.16	0.02-1.37	=0.095
	El Dorado	1.02	0.68-1.53	=0.925
	Nevada	2.25	1.46-3.48	<0.001
	Placer	0.77	0.55-1.06	=0.108
	San Joaquin	0.62	0.45-0.85	=0.003
	Stanislaus	0.53	0.37-0.76	=0.001
	Sutter	0.81	0.48-1.40	=0.456
	Yuba	0.73	0.47-1.14	=0.17
	Yolo	0.63	0.32-1.23	=0.173

[###] Too few patients to be evaluated

[***] Referent population