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Breaking Barriers to Breast Reconstruction among Socioeconomically Disadvantaged Patients at a Large Safety-net Hospital

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Background: Socioeconomic disparities remain prevalent among those who undergo breast reconstruction. At our institution, patients must meet certain criteria to become eligible for breast reconstruction. The purpose of this study was to determine the impact of socioeconomic factors on breast reconstruction eligibility, enrollment, choice, and completion at our large safety-net institution.

Methods: A retrospective chart review of patients who underwent partial or total mastectomy at a large safety-net hospital from 2016 to 2019 was completed. Surgical and demographic data were compared across varying socioeconomic factors.

Results: A total of 645 patients were included in the study. More patients of a racial minority had government-based insurance than White patients (89% versus 81%; $P = 0.01$). Those with government-based insurance had higher average hemoglobin A1c values (6.26 versus 6.0; $P = 0.03$), proportion of American Society of Anesthesiologists scores greater than III (46% versus 40%; $P = 0.01$), and smokers (23% versus 9%; $P = 0.02$) than those with private insurance. Diabetic patients, patients with an American Society of Anesthesiologists greater than III, and active smokers were significantly less likely to receive a plastic surgery consult. Patients with government-based insurance underwent immediate tissue expander placement at mastectomy at rates lower than those with private insurance (57% versus 69%; $P = 0.01$).

Conclusions: Barriers remain for socioeconomically disadvantaged patients to be eligible for, undergo, and complete breast reconstruction. Obesity, diabetes, smoking, and poor overall health were identified as the main barriers and were associated with racial minorities, government-based insurance, and lower incomes. Concerted effort through multidisciplinary teams is needed to maximize eligibility of socioeconomically disadvantaged breast cancer patients for reconstruction. (*Plast Reconstr Surg Glob Open* 2022;10:e4410; doi: [10.1097/GOX.0000000000004410](https://doi.org/10.1097/GOX.0000000000004410); Published online 5 July 2022.)

INTRODUCTION

In the United States, roughly 3.8 million women were living with breast cancer in 2019, making it the second most common cancer in women.¹ About one-third of women diagnosed with early-stage breast cancer undergo

mastectomy for treatment.² Postmastectomy breast reconstruction has been shown to greatly improve patients' health-related quality of life, and psychosocial, sexual, and physical well-being.³⁻⁵ This evidence led to the development of the 1998 federal Women's Health and Cancer Rights Act, which mandates all-payer health insurance coverage of all stages of breast reconstruction, including breast symmetry procedures.⁶ Although postmastectomy breast reconstruction rates increased following this enactment, socioeconomic and racial disparities continue to persist among those who undergo breast reconstruction.⁷⁻¹³

The main reconstructive options offered to a patient following mastectomy are implant-based or autologous reconstruction.¹⁴⁻¹⁸ Patient-reported outcomes have shown autologous reconstruction to be significantly superior to implant-based reconstruction in terms of breast

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satisfaction and psychosocial well-being.^{3,4,19} However, in recent years, the relative portion of implant-based reconstruction has risen nationally, while autologous reconstruction rates have comparably declined.^{9,20}

Socioeconomic factors, including patient race and ethnicity, health-care literacy, language preference, and educational level, have been shown to be key determinants of access to breast reconstruction.⁸ Studies consistently demonstrate that Hispanic and African American women are less likely to undergo reconstruction than their White counterparts.²¹ Additionally, women with federally funded health insurance have been found to undergo breast reconstruction at substantially lower rates than women with private insurance.^{8,22}

Although previous studies have established differing breast reconstruction rates based on socioeconomic factors, the influence of socioeconomic status (SES), as defined by race, insurance type, and income levels, on breast reconstruction eligibility, modality choice, and completion rates has not been fully explored. This study focuses on the patient population seen at a large safety-net institution in a major US metropolitan city, where many challenges persist with regard to delivering safe and effective care to breast cancer patients. We have found that our institution has higher rates of obesity, diabetes, and smokers, compared to the general population, as well as higher than average complication rates within our breast reconstruction patient population.²³ To combat this rise in complications, the following criteria must be met by patients to pursue breast reconstruction at our institution: body mass index (BMI) less than 40 kg/m², hemoglobin A1c (HbA1c) less than 7%, and nonsmoking status before breast reconstruction. Greater control of existing comorbidities associated with increased risk for complications is indicated by American Society of Anesthesiologists (ASA) scores less than III. In this study, we sought to analyze the impact of SES on our breast cancer patients' eligibility for breast reconstruction, their choice of reconstructive modality, and the rate of completion of breast reconstruction at our safety-net hospital. We hypothesized that patient race, insurance type, and income levels would influence our patients' eligibility for breast reconstruction given our institution's screening criteria and would play a role in rates of completion of breast reconstruction.

PATIENTS AND METHODS

After institutional review board approval, a retrospective chart review of all patients who underwent mastectomies at a major safety-net hospital from October 2016 to October 2019 was completed. All patients diagnosed with breast cancer who underwent lumpectomy (partial mastectomy) or mastectomy (radical, skin-sparing, modified radical, and subcutaneous) for a breast mass were included. The CPT codes utilized for patient selection were 19303, 19302, and 19035, whereas ICD-10 codes included C50.911 (breast cancer), Z90.12 (mastectomy), Z42.1 (lumpectomy), and N63.0 (breast mass). Patient medical record number, date of birth, and zip code were also extracted.

Takeaways

Question: Do socioeconomic factors affect a patient's breast reconstruction eligibility, choice, and completion?

Findings: A retrospective chart review showed that patients with county-based or government-based insurance underwent immediate breast reconstruction at rates lower to those with private insurance. This patient population also had higher average hemoglobin A1c levels, proportion of smokers, and higher ASA scores.

Meaning: Current screening guidelines at our institution may be disproportionately affecting individuals of lower socioeconomic status. A multidisciplinary approach is necessary to optimize patients' eligibility for breast reconstruction.

Chart review was performed from the extracted medical record numbers using electronic medical records to record demographic and socioeconomic information, including age, insurance type, and mean household income, as determined by patient zip code. The US Census Data were used to estimate mean household income based on the patients' zip code provided in their chart.²⁴ The patient cohort was stratified into quartiles based on household income, with quartiles one (Q1) and two (Q2) falling below the median state income, and quartiles three (Q3) and four (Q4) above the median state income. Comorbidities, including BMI, diabetic status, smoking status, ASA classification, and medical and surgical history, were recorded. Oncologic characteristic and treatment data, such as cancer stage, type of resection, and perioperative chemotherapy and radiation therapy, were collected. Data points pertaining to breast reconstruction, such as plastic surgery referral, reconstruction options offered to the patient, timing and type of reconstruction, complications, and the number of secondary revisions, were documented. All mastectomies were performed by a breast surgeon, and all breast reconstructions were performed by a plastic surgeon.

A delayed immediate approach is utilized at our institution for breast reconstruction, with tissue expander (TE) placement at the time of mastectomy, followed by subsequent outpatient expansion and replacement with permanent implant or autologous reconstruction. Direct-to-implant reconstruction after mastectomy was considered as definitive breast reconstruction for this study.

Univariable analysis using Pearson's Chi square test was used to compare demographic information, medical comorbidities, treatment, and reconstructive modalities between private and government-based insurance. Socioeconomic factors, including mean household income, insurance type, and race, were then compared across cancer stages and reconstruction procedures. Patients with county-based insurance and Medicaid patients were grouped into the government-based insurance cohort for this study, whereas patients with Medicare were excluded from our analyses. Multivariable logistic regression was utilized to compare dependent categorical variables to independent categorical variables. The

dependent variables were adjunct radiotherapy treatment, TE placement at time of mastectomy, definitive breast reconstruction, and complications. The independent variables were demographic data and medical comorbidities, including insurance type, income quartiles, diabetic status, smoking status, and ASA score.

Statistical analysis was performed using R and SPSS software (IBM Corporation, Armonk, NY). A *P* value of less than 0.05 was considered significant.

RESULTS

Patient Demographics and Cancer Profile

From 2016 to 2019, 645 breast cancer patients were identified and met inclusion criteria for this study. Patient demographics and cancer profiles are summarized in Table 1. Average age for all patients undergoing breast-conserving surgery and also mastectomy was 56.1 years (± 11.9), and the most common BMI category was obese, 30–39.9 kg/m² (43%), followed by overweight, 25–29.9 kg/m² (30%), normal, <25 kg/m² (16%), and morbidly obese, >40 kg/m² (11%). The majority of the study population

was either Hispanic (50%) or African American (36%), followed by White (13%), then Asian (1%). Twenty-seven percent (*n* = 174) of patients were diagnosed with type 2 diabetes mellitus, with a mean HbA1c of 6.3% (± 1.4); 22% of these patients had HbA1c values greater than 7%. Seventy percent (*n* = 449) of the cohort were nonsmokers, while 20% (*n* = 131) were former smokers, and 10% (*n* = 65) were active smokers at the time of the mastectomy procedure. Most patients had either an ASA score of II (46%) or III (50%). Within our patient cohort, 38% of patients (*n* = 246) had county financial assistance-based insurance, 26% (*n* = 171) had Medicaid, 18% (*n* = 117) had Medicare, 9% (*n* = 58) had private-based insurance, and the remaining 9% (*n* = 58) had unspecified insurance type. The largest portion of patients fell within the lowest mean household income range of Q1 (27%), whereas 25% of patients belonged to Q2, 24% to Q3, and 24% to Q4.

The majority of patients presented at an early stage of breast cancer: 24% of patients presented with stage 0 breast cancer, 34% with stage I, 24% with stage II, 15% with stage III, and 3% with stage IV. Of all 645 patients undergoing surgical breast cancer treatment, 50.1% (*n* = 331) underwent partial mastectomy/lumpectomy, while 49.9% (*n* = 314) underwent total mastectomy.

There were 134 patients who underwent complete mastectomy but did not undergo immediate breast reconstruction with TE placement (Fig. 1). Of these, 38 patients (28%) declined a referral to see the plastic surgeon, 37 (28%) were deemed not an immediate reconstruction candidate, 29 (22%) had delayed reconstruction, 21 (16%) were seen by plastic surgery, but declined reconstruction, 3 (2%) were referred to plastic surgery but did not appear for their appointment, and the remaining 6 (4%) patients had unknown reasons for not undergoing reconstruction. Out of those that were not a reconstruction candidate, 30% were smokers, 24% had an HbA1c greater than 6.5%, and 46% had other contraindications to reconstruction such as high BMI, metastatic disease, or multiple comorbidities.

Surgical Data

Of the 314 patients who underwent total mastectomy, 56.7% (*n* = 178) patients underwent immediate TE placement at time of mastectomy, while two patients underwent direct-to-implant breast reconstruction at time of mastectomy. Following immediate TE placement, 75.3% (*n* = 134) of these patients underwent definitive breast reconstruction. Of these, 42.5% (*n* = 57) had implant-based reconstruction, while 57.5% (*n* = 77) underwent autologous reconstruction (Fig. 2). Patients with a higher BMI had higher rates of autologous-based reconstruction compared with implant-based reconstruction (56% versus 40%; *P* = 0.00). Finally, 24.7% (*n* = 44) of patients who underwent immediate TE placement did not undergo definitive breast reconstruction due to TE removal for infection or personal choice, delayed reconstruction secondary to ongoing cancer treatments or comorbidities, or were still awaiting definitive reconstruction at the time of data collection.

Table 1. Patient Demographics

Age, y	56.1 \pm 11.9
Race	
Hispanic	311 (50%)
African American	224 (36%)
White	83 (13%)
Asian	7 (1%)
BMI	
Normal <25	106 (16%)
Overweight	193 (30%)
Obese	278 (43%)
Morbidly obese	73 (11%)
Diabetes (type 2)	174 (27%)
HbA1c (mean \pm SD)	6.31 \pm 1.4
Smoking status	
Never	449 (70%)
Former	131 (20%)
Active	65 (10%)
ASA score	
I	19 (3%)
II	299 (46%)
III	321 (50%)
IV	6 (1%)
Medical/surgical history	
MI	12 (1.8%)
CABG	6 (0.9%)
Abdominoplasty	7 (1.1%)
Cholecystectomy	33 (5%)
Insurance provider	
County Financial Assistance	246 (38%)
Medicaid	171 (26%)
Medicare	117 (18%)
Private	58 (9%)
Unspecified	58 (9%)
Cancer Profile	
Type	
DCIS	21%
IDC	61%
ILC	3%
Other	15%
Cancer stage	
0	24%
I	34%
II	24%
III	15%
IV	3%

CABG, coronary artery bypass grafting; DCIS, ductal carcinoma in situ; IDC, invasive ductal carcinoma; ILC, invasive lobular carcinoma; MI, myocardial infarction.

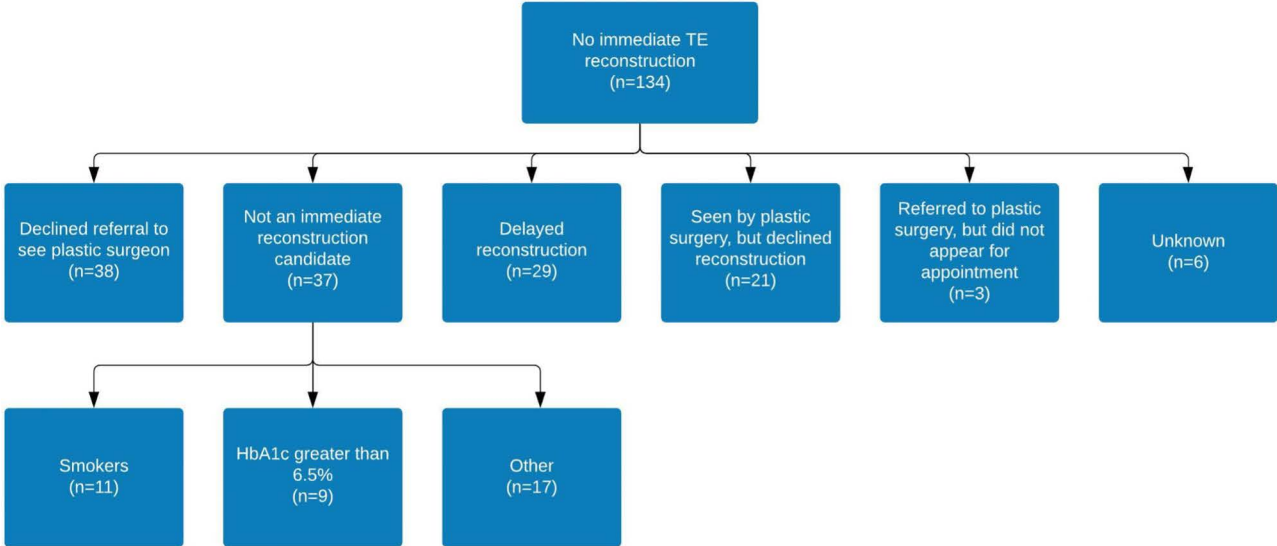


Fig. 1. Patients who did not undergo immediate TE placement at time of mastectomy.

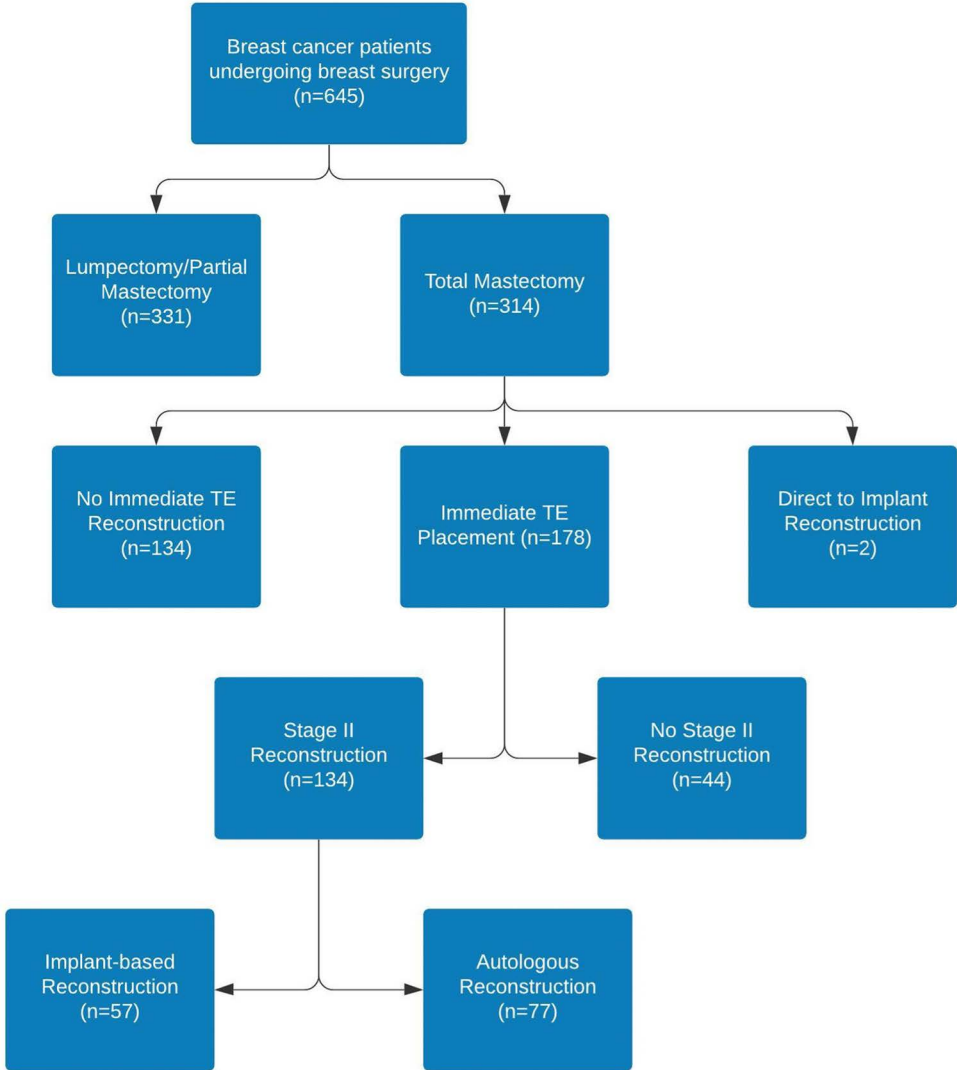


Fig. 2. Patients undergoing breast surgery.

The overall complication rate following TE placement was 35% (n = 64), with most of these complications being related to infection. The complication rate following definitive breast reconstruction with either autologous-based or implant-based reconstruction was 5% (n = 27). Complications included infection, skin erythema, wound dehiscence, and mastectomy flap necrosis. Forty percent of patients who completed definitive breast reconstruction underwent subsequent revision surgeries (n = 54); 31% (n = 17) of these were implant-based and 69% (n = 37) were autologous-based. Most of our study population completing definitive breast reconstruction (85%) had one revision surgery.

Socioeconomic Impact

Patients with household incomes in the two higher income quartiles were more likely to have private insurance than government-based insurance compared with those in the lower income quartiles (58% versus 49%; $P = 0.02$). Those with government based-insurance were significantly more likely to be of a racial minority (89% versus 81%; $P = 0.00$), had significantly higher mean HbA1c levels (6.26 ± 1.4 versus 6.0 ± 1.1 ; $P = 0.03$), were actively smoking (23% versus 9%; $P = 0.02$), and had poorer health, as indicated by an ASA score greater than III (46% versus 40% $P = 0.01$) [Table 2](#).

The impact of socioeconomic factors on the patient's breast cancer care is summarized in [Table 3](#). No significant differences were found in cancer stage at presentation, rate of adjunct radiotherapy or chemotherapy, or oncologic treatment based on socioeconomic factors. Following total mastectomy, those with government-based insurance were less likely to undergo TE placement at time of mastectomy than those with private insurance (57% versus 69%; $P = 0.005$). Additionally, more patients

of a racial minority underwent immediate TE placement than their White counterparts (60% versus 52%; $P = 0.00$). Patients in the lower income quartiles completed definitive breast reconstruction at lower rates than those in the upper income quartiles (38% versus 45%; $P = 0.03$), while insurance type and race did not seem to play a significant role on completion of breast reconstruction. No significant differences in rates of complications or revisions following TE placement or definitive breast reconstruction were found based on socioeconomic factors.

Multivariable Logistic Regression

Multivariable logistic regression results are summarized in [Table 4](#). Socioeconomic factors, as defined by racial minority, government-based insurance, and lower household incomes, did not have a significant effect on plastic surgery referral patterns, rates of not undergoing immediate breast reconstruction, and completion of breast reconstruction. Patients with diabetes, higher ASA scores reflecting poorer overall health, and smokers were less likely to receive a referral to and treatment from a plastic surgeon. At our institution, diabetic patients are more likely to undergo partial mastectomy and radiation compared with nondiabetic patients [odds ratio (OR), 1.6; CI, 1.1–2.3]. If offered total mastectomy, nondiabetic patients are significantly more likely to undergo immediate breast reconstruction (OR, 6.4; CI, 3.2–12.7), and complete definitive breast reconstruction (OR, 4.9; CI, 2.3–10.44) compared with diabetic patients.

Complications

All patients undergoing total mastectomy had greater odds of having complications following immediate TE placement with a BMI $>30 \text{ kg/m}^2$ (OR, 5.3; CI, 1.1–25). There were 26 patients who underwent total mastectomy with breast reconstruction and adjunct radiation therapy; 11 of these patients developed postoperative complications, while the remaining 15 did not. As determined from the multivariate logistic regression, adjunct radiation therapy provided a protective benefit on complication rate in patients undergoing TE-placement at time of total mastectomy (OR, 0.5; CI, 0.30–0.9). No significant differences were found among patients with complications following definitive breast reconstruction. Most complications included infection, seroma, wound dehiscence, and mastectomy flap necrosis.

DISCUSSION

This study sought to determine whether different socioeconomic factors, as defined by race, insurance type, and household income, influenced breast reconstruction eligibility, modality, and completion at a large safety-net academic institution. The overall rate of immediate breast reconstruction following mastectomy at our institution is comparable to national trends.^{9,20} Of the patients who underwent complete mastectomy at our institution (n = 314), 57.3% (n = 180) underwent immediate reconstruction, a higher rate compared with other safety-net institutions.²⁵ In 2017, Ballard et al²⁵ found that 46% of patients

Table 2. Association of Insurance Type with Patient Demographics and Oncologic Treatment

Patient Characteristics	Private Insurance (n = 58)	Government Insurance (n = 476)	P
Mean Income			
Higher quartiles (Q3/Q4)	33 (57%)	237 (49%)	0.02
Race			
Minority	47 (81%)	423 (89%)	0.01
White	11 (19%)	53 (11%)	
BMI			
Obese (>30)	22 (39%)	254 (53%)	0.20
Diabetes	9 (16%)	112 (24%)	0.06
HbA1c	6.0 ± 1.1	6.26 ± 1.4	0.03
Smoking status			
Yes	5 (9%)	108 (23%)	0.02
No	53 (91%)	368 (77%)	
ASA			0.01
I + II	1 (2%)	18 (4.9%)	
II	33 (58%)	233 (49%)	
III + IV	23 (40%)	219 (46%)	
IV	0 (0%)	2 (0.1%)	
Adjunct XRT	33 (58%)	301 (63%)	0.4
Adjunct chemotherapy	21 (37%)	158 (33%)	0.75
Did not see plastics	24 (42%)	261 (55%)	0.13
Mastectomy procedure			
Lumpectomy	30 (53%)	216 (45%)	0.15
Complete mastectomy	27 (47%)	260 (55%)	

XRT, radiotherapy.

Table 3. Breast Cancer Stage and Reconstructive Procedures Based on SES Factors

Surgical Characteristics	Q3/Q4	Q1/Q2	P	Private Insurance	Government Insurance	P	Racial Minority	White	P
Stage of Cancer	n = 301	n = 316	0.08	n = 53	n = 445		n = 535	n = 89	0.33
0 (DCIS/LCIS)	63 (21%)	65 (21%)		11 (21%)	85 (19%)		110 (21%)	17 (19%)	
I	101 (34%)	120 (38%)		20 (38%)	154 (35%)		187 (35%)	33 (37%)	
II	83 (28%)	72 (23%)		17 (32%)	115 (26%)		137 (26%)	27 (30%)	
III	45 (15%)	52 (16%)		4 (7%)	79 (18%)		88 (16%)	9 (11%)	
IV	9 (2%)	7 (2%)		1 (2%)	12 (2%)		13 (2%)	3 (3%)	
Complete Mastectomy	n = 155	n = 167		n = 26	n = 221		n = 216	n = 31	
Immediate TE placement/direct-to-implant	84 (54%)	93 (56%)	0.92	18 (69%)	127 (57%)	0.01	129 (60%)	16 (52%)	0.00
Complications after TE placement/direct-to-implant	29 (19%)	31 (18%)	0.88	9 (35%)	40 (18%)	0.06	42 (19%)	7 (23%)	0.06
Definitive breast reconstruction completed	70 (45%)	63 (38%)	0.03	12 (46%)	87 (39%)	0.11	88 (41%)	15 (48%)	0.4
Complications after definitive breast reconstruction	16 (10%)	10 (6%)	0.55	3 (12%)	17 (8%)	0.29	17 (8%)	3 (10%)	0.73
Definitive breast reconstruction modalities	n = 70	n = 63		n = 12	n = 87		n = 88	n = 15	
Implant-based	29 (41%)	20 (32%)	0.86	6 (50%)	34 (39%)	0.53	41 (47%)	8 (53%)	0.59
Autologous	41 (59%)	43 (68%)		6 (50%)	53 (61%)		17 (8%)	7 (47%)	
Secondary revisions	22 (31%)	20 (32%)	0.94	3 (25%)	39 (45%)	0.13	37 (42%)	5 (33%)	0.78

Bold values indicate statistical significance, as indicated by a *p* value less than 0.05.

at non-safety-net hospitals underwent immediate reconstruction compared with only 31% of patients at safety-net hospitals. Of the 314 patients undergoing complete mastectomy for treatment of breast cancer, 230 (73.2%) were referred to and seen by plastic surgery.

Most of our breast cancer patients were obese or morbidly obese (53%), and a significant number were diabetic (27%) and actively smoking (10%). It is well established that obesity, increased age, and smoking are major independent risk factors for complications in breast reconstruction.²⁶ To curb complications, our institution uses a referral screening process whereby patients with uncontrolled diabetes mellitus (HbA1c > 7%), BMI greater than 40 kg/m², significant comorbidities, and who are active smokers are referred to appropriate medical services to mitigate these comorbidities before undertaking breast reconstruction. As a result, 11.8% of patients who underwent total mastectomy were not deemed candidates for immediate breast reconstruction.

Although having government-based insurance had no influence on plastic surgery referral patterns, patients with government-based insurance underwent immediate breast reconstruction at significantly lower rates than those with private insurance. This same group of patients with government-based insurance had significantly higher average HbA1c levels, rates of ASA scores greater than III, and proportion of smokers. Our multivariable logistic regression analysis demonstrated that patients with a type 2 diabetes diagnosis, with an ASA score greater than III and who were actively smoking, were significantly less likely to receive a plastic surgery referral. Therefore, our patients from socioeconomically disadvantaged backgrounds are being seen by plastic surgery yet fail to meet our eligibility criteria. To improve these patients' eligibility for immediate reconstruction, efforts should be directed at mitigating these risk factors through outreach programs and access to primary care. At our institution, the patients who do not meet our screening criteria are referred to appropriate services to address and improve upon their comorbidities before breast reconstruction. Many patients following optimization of their overall general health, as

indicated by lower HbA1c and BMI levels, are encouraged to return to clinic to engage in conversations regarding delayed breast reconstruction. Of the 134 patients in our study who did not undergo immediate breast reconstruction with TEs placed at time of mastectomy, 21.6% (n = 29) underwent delayed breast reconstruction.

Furthermore, of patients who did not pursue immediate breast reconstruction, 16% decided to forego reconstruction after initial plastic surgery consultation, while 28% declined a referral to plastic surgery; their reasons are personal and could be the subject of another study.

Not surprisingly for a safety-net hospital, the majority of the patients included in this study belong within a minority group, are in the lower income quartiles, and have government-based insurance of either Medicaid or county-based insurance. Although previous studies have found that fewer racial minority patients undergo breast reconstruction than White patients, our study showed the opposite trend in our population; the reason for which being likely multifactorial.⁸ Some of the contributing factors may include access to multimedia Spanish language content on breast reconstruction and dedicated in-person Spanish interpreters who are well educated on breast reconstruction at our institution.

Patients in the lower income quartile had lower rates of completion of definitive breast reconstruction, while patients' race and insurance type had no significant effect. Anecdotal reports from patients who chose to remove TEs and not proceed with further reconstruction varied; some patients mentioned additional time away from work or home as a disadvantage to pursuing further reconstruction, while others quoted discomfort from having implants or were worried about potential complication and additional surgery and cost in the future. Additional studies are necessary to examine non-surgical-related factors to breast reconstruction failure.

Regarding choice of reconstructive modality, previous studies have found autologous breast reconstruction to be more common among privately insured patients within both single institution and nation-wide studies.^{27,28} One

Table 4. Multivariable Logistic Regression

Dependent Variables	Demographic and Socioeconomic Factors	P	OR (95% CI for OR)
Receiving plastic surgery consult	Government-based insurance	0.06	0.64 (0.40–1.02)
	Age	0.96	1.00 (0.99–1.02)
	Racial minority	0.10	1.50 (0.92–2.44)
	BMI >30	0.29	0.83 (0.58–1.18)
	Type 2 diabetes diagnosis	0.00	0.30 (0.18–0.49)
	ASA ≥3	0.04	0.69 (0.49–0.98)
	Q1	0.77	
	Q2	0.76	1.08 (0.66–1.78)
	Q3	0.90	0.97 (0.59–1.59)
	Q4	0.47	0.83 (0.51–1.37)
	Adjunct XRT	0.31	0.83 (0.58–1.19)
	Adjunct chemotherapy	0.73	1.08 (0.69–1.71)
	Active smoker	0.00	0.30 (0.10–0.40)
	Immediate TE placement/direct-to-implant breast reconstruction	Government-based insurance	0.17
Age		0.477	0.994 (0.977–1.011)
Racial minority		0.302	0.757 (0.446–1.285)
BMI >30		0.201	1.284 (0.875–1.884)
Type 2 diabetes		0.00	5.228 (2.784–9.82)
ASA ≥3		0.112	1.365 (0.93–2.001)
Q1		0.863	
Q2		0.903	1.034 (0.605–1.768)
Q3		0.994	0.998 (0.585–1.702)
Q4		0.475	1.219 (0.709–2.096)
Adjunct XRT		0.332	1.217 (0.819–1.808)
Adjunct chemotherapy		0.875	0.961 (0.585–1.579)
Active smoker		0.002	0.264 (0.116–0.602)
Final definitive breast reconstruction		Government-based insurance	0.398
	Age	0.306	0.99 (0.972–1.009)
	Racial minority	0.144	0.628 (0.337–1.172)
	BMI >30	0.749	1.073 (0.697–1.651)
	Type 2 diabetes	0.00	6.019 (2.872–12.613)
	ASA ≥3	0.523	1.151 (0.748–1.771)
	Q1	0.147	
	Q2	0.462	0.801 (0.444–1.446)
	Q3	0.151	0.64 (0.348–1.177)
	Q4	0.46	1.246 (0.695–2.232)
	Adjunct XRT	0.399	1.211 (0.776–1.89)
	Adjunct chemotherapy	0.276	1.352 (0.786–2.326)
	Active smoker	0.004	0.172 (0.052–0.564)
	Postoperative complications	Government-based insurance	0.11
Age		0.64	0.99 (0.95–1.03)
Ethnicity		0.25	1.95 (0.63–6.02)
BMI >30		0.03	5.35 (1.14–25.01)
Type 2 diabetes		0.98	
ASA ≥3		0.45	1.24 (0.72–2.14)
Q1		0.61	
Q2		0.40	1.39 (0.65–2.98)
Q3		0.95	1.02 (0.48–2.19)
Q4		0.27	1.55 (0.71–3.37)
Adjunct XRT		0.02	0.53 (0.30–0.92)
Adjunct chemotherapy		0.08	1.66 (0.94–2.92)
Active smoker		0.45	1.52 (0.52–4.49)

DCIS, ductal carcinoma in situ; LCIS, lobular carcinoma in situ; XRT, radiotherapy.

reason that patients may not be offered autologous reconstruction is insurance-type and declining reimbursement rates. For government-based insurance patients, surgeon reimbursement is less than that of private insurance.²⁹ Despite this finding, there was no significant difference in autologous reconstruction in our patient population based on private versus government-based insurance, income quartile, or race. More patients in our population underwent autologous breast reconstruction than implant-based reconstruction (61% versus 39%). This also differs from the national trend, which reports rising rates of implant-based breast reconstruction.^{9,20} Previous studies conducted at our institution showed a high average BMI in our patient population.²³ In our current study, the factor most significantly associated with undergoing autologous reconstruction was a higher BMI. The majority of autologous reconstruction performed at our academic

center is abdominal-based, with 86% of these reconstructions being deep inferior epigastric perforator (DIEP) free flap-based. Given ample donor site and literature support for potentially better outcome, more autologous reconstruction is performed in our patient population with higher BMI levels.^{30,31}

The rate of complications and revision procedures was not impacted by socioeconomic factors investigated in this study. Risk factors for complications of breast reconstruction are well studied.^{15,32} This study showed that some of these risk factors are clearly associated with socioeconomic factors, such as the association of government-based insurance with smoking, DM, and higher ASA scores. The fact that these factors did not impact complications could be attributed to the preoperative screening process used at our institution. Though this tool lowers the potential for complications, it does not change medical eligibility.

Significant strides can be made to optimize and improve the overall health of our breast cancer patients within the lower income quartiles and with government-based insurance.

This study is limited by its restriction to a single institution and being retrospective in design. There is also limited applicability of our results to other areas of the country. For example, median income in our area may be different from the median income in other geographic locations. Furthermore, our use of zip code to estimate the household income of our patient comes with inherent margin of error. The number of private-based insurance patients is low in our study, thus possibly affecting the statistical significance across our different analyses.

CONCLUSIONS

Barriers remain for socioeconomically disadvantaged patients to be eligible for, undergo, and complete breast reconstruction. At our safety-net institution, access to breast reconstruction is universal and is not influenced by a patient's socioeconomic status, yet patients with government-based insurance and of lower income status underwent immediate breast reconstruction and completion of breast reconstruction at significantly lower rates than their counterparts of higher SES. Obesity, diabetes, smoking, and poor overall health were shown to be strongly associated with lower SES, as indicated by lower income quartiles and government-based insurance, and were identified to be the main barriers to breast reconstruction eligibility and completion in this study. Concerted effort through hospital systems, public health entities, social work, and primary physicians is needed to maximize eligibility of socioeconomically disadvantaged breast cancer patients for reconstruction.

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