

Multilevel Analysis of the Impact of Community vs Patient Factors on Access to Immediate Breast Reconstruction Following Mastectomy in Maryland

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Objective: To determine whether various individual factors such as patient demographics and various community factors such as characteristics of the neighborhood in which the patient lives would influence access to immediate breast reconstruction.

Design: Multilevel analysis of the Maryland Hospital Discharge Database, a prospectively collected observational database of inpatient care for all hospitals in Maryland.

Setting: Database analysis.

Patients: We queried for *International Classification of Diseases, Ninth Revision* procedure codes for all patients undergoing mastectomy and reconstruction during the same hospitalization in Maryland from January 1, 1995, through December 31, 2004.

Main Outcome Measures: Disparities in immediate reconstruction rates via analysis of the impact of patient-level and community-level factors.

Results: A total of 18 690 patients underwent mastectomy in Maryland during the study period, 27.9% of whom had immediate reconstruction. On multivariate analysis, patient factors such as African American race/ethnicity and older age had a negative association. Community factors such as increasing household income, increasing population density, and increasing proportion of the community with at least some college education had a positive association, while increasing home value and increasing African American composition of the patient's neighborhood had a negative association. The impacts of ethnic/racial mix and educational level of the patient's neighborhood were independent of the patient's race/ethnicity.

Conclusions: Community factors beyond patient characteristics have a significant association with immediate reconstruction. Prospective community-level public health policy measures should be developed to address these inequalities (particularly racial/ethnic disparities based on neighborhood) and to increase the likelihood of obtaining immediate reconstruction.

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BREAST CANCER, ONE OF THE most common malignant neoplasms in North America, affects 134 of 100 000 women each year in the United States and varies significantly among races/ethnicities: the incidence of breast cancer is 141 cases per 100 000 women per year among white women, 55 cases among Native American Indian and Alaskan Native women, and 119 cases

among African American women.¹ The mortality rate also differs among races/ethnicities, ranging from 13 deaths per 100 000 women per year among Asians and Pacific Islanders to 35 deaths among African American women.¹ Whenever feasible, most women prefer breast-conserving therapy; however, certain women undergo mastectomy because of personal choice, multicentricity, large tumor to breast size ratio, inflammatory breast cancer, or other contraindications to breast-conserving therapy such as the inability to undergo radiation therapy. Immediate reconstruction has been shown to be superior to delayed reconstruction for overall aesthetics,^{2,3} psychosocial well-being,^{4,7} and cost-effectiveness.^{8,9} Immediate reconstruction is safe in terms of recurrences during the short-term¹⁰ and long-term¹¹⁻¹⁵ and does not mask future recurrences^{16,17} even for advanced-stage breast cancer.¹⁸ With these established benefits of immediate breast reconstruction, we hypothesized that we could use immediate reconstruction as a surrogate for optimal therapy and access to care for patients undergoing mastectomy.

The racial/ethnic disparities that have been shown in other areas of medicine, including lung cancer,¹⁹ prostate cancer,²⁰ and heart disease,²¹ also apply to breast

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among African American women.¹ The mortality rate also differs among races/ethnicities, ranging from 13 deaths per 100 000 women per year among Asians and Pacific Islanders to 35 deaths among African American women.¹

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cancer and were noted as early as the 1950s.²² Findings from a recent study²³ from The University of Texas M. D. Anderson Cancer Center showed that African Americans had decreased rates of the following: referrals to plastic surgeons for possible reconstruction, acceptance of those possible referrals, reconstruction offered by their plastic surgeons, and performance of reconstruction if it was offered.

In this study, we focus on individual and community factors that may affect access to immediate breast reconstruction in the state of Maryland. Most previous studies on racial/ethnic disparities have focused on patient characteristics. We believe that community factors beyond the patients may affect patient access to health care: an African American patient living in a primarily African American neighborhood will have a different experience with the health care system vs that of a similar patient who lives in a primarily white neighborhood. Therefore, in our assessment of racial/ethnic disparities in breast cancer treatment, we sought to determine if neighborhood factors in addition to individual demographics affected the use of immediate breast reconstruction.

METHODS

We performed a retrospective analysis of the Maryland Hospital Discharge Database, which is a prospectively collected observational database of inpatient care in all hospitals in Maryland. This comprehensive database contains information regarding hospital discharge, length of hospital stay, treating diagnoses, inpatient procedures, inpatient mortality, complications, demographics, and payer information for Maryland. Fifty institutions, including all academic medical centers and community hospitals, are required to enter discharge information regarding all patients cared for in Maryland. Submission is mandated and regulated through the Maryland Health Services Cost Review Committee. Community demographics data for 2002 are provided by commercially available software (MapPoint, version 2004; Microsoft, Redmond, Washington). Community demographic variables included the median household income of the community by zip code, population density of the community by zip code, percentage of the community population by zip code with at least some college education, percentage of the community population by zip code who are African American, median home value by zip code, and percentage of households by zip code with computer access. Linkage between the patient data and the community demographics data was by patients' home zip codes based on 2002 community data. The 2002 data were used because they were the latest available data. We believe that the relative values of those factors would not change over time even if the absolute values may fluctuate.

The Johns Hopkins Medicine Institutional Review Board reviewed our study protocol. The board declared it exempt from informed consent because of the lack of protected health information contained in the databases and because of the public accessibility of the data.

We queried for all *International Classification of Diseases, Ninth Revision (ICD-9)* procedure codes that could describe mastectomy and breast reconstruction during the same hospitalization for all patients in Maryland from January 1, 1995, through December 31, 2004. The few mastectomies that were performed as outpatient procedures were not captured. The ICD-9 procedure codes that corresponded with mastectomies in-

cluded 85.23 (subtotal mastectomy), 85.4 (mastectomy), 85.41 (unilateral simple mastectomy), 85.42 (bilateral simple mastectomy), 85.43 (unilateral extended simple mastectomy), 85.44 (bilateral extended simple mastectomy), 85.45 (unilateral radical mastectomy), 85.46 (bilateral radical mastectomy), 85.47 (unilateral extended radical mastectomy), and 85.48 (bilateral extended radical mastectomy). The ICD-9 procedure codes that could describe breast reconstruction included 85.35 (bilateral subcutaneous mammectomy-implant), 85.53 (unilateral breast implant), 85.54 (bilateral breast implant), 85.7 (total breast reconstruction), 85.84 (breast pedicle graft), 85.85 (breast muscle flap graft), and 85.95 (insertion of breast tissue expanders).

We assumed that any patient who had 1 of the procedure codes describing mastectomy plus 1 of the codes describing some form of reconstruction during the same hospitalization would represent a patient who underwent mastectomy followed by immediate reconstruction. We believe that most of these patients underwent mastectomy for breast cancer treatment or for cancer risk reduction because of strong positive family history or genetics. It is possible that a few patients may have undergone mastectomy and reconstruction for unusual diagnoses such as severe mastodynia or traumatic breast injury. These cases are considered too rare to affect our analysis.

The primary outcome of interest was access to immediate breast reconstruction following mastectomy. Comparison between groups was performed using χ^2 analysis for categorical variables and Wilcoxon rank sum test for medians for continuous variables. We performed multivariate analysis to examine the association between individual patient demographics and their community factors vs the likelihood of immediate breast reconstruction. In the multivariate analysis, the community-level and individual-level factors are analyzed together.

Statistical significance was set at $P < .05$. Logistic regression analysis was performed using commercially available statistical software (STATA; StataCorp LP, College Station, Texas).

RESULTS

From January 1, 1995, through December 31, 2004, a total of 18 690 patients underwent mastectomy in Maryland. For this population as a whole, the mean age was 60.1 years (median age, 59 years). Among 17 925 patients analyzed, 14 033 (78.3%) were white, and 3892 (21.7%) were African American. These patients had a mean household income in 2002 of \$68 727 (median, \$66 407), with a mean home value in 2002 of \$141 924 (median, \$132 524). The mean density per square mile for the patients' home zip code areas was 3250 (median, 2163). The mean percentage of the population with a high school education or less was 22.4% (median, 22.3%). The mean percentage of African Americans in the patients' home zip code areas was 26.4% (median, 17.3%).

We focused our comparison analysis on white subjects and on the largest minority group in Maryland, African American subjects, eliminating 765 patients in other racial/ethnic groups. Among 17 925 patients analyzed, 4994 patients (27.9%) underwent a breast reconstruction procedure during the same hospitalization as their mastectomy. The patients who received immediate reconstruction were younger (mean age, 50.0 vs 64.0 years; $P < .001$), less likely to be African American (829 of 4994

Table 1. Comparison of Characteristics Between Patients Who Received vs Did Not Receive Immediate Reconstruction Following Mastectomy for Breast Cancer in Maryland From 1995 to 2004

Characteristic	Patients Who Received Immediate Reconstruction	Patients Who Did Not Receive Immediate Reconstruction	P Value
Individual Factors			
African American race/ethnicity, No./total No. (%)	829/4994 (16.6)	3063/12 931 (23.7)	<.001
Age, mean, y	50.0	64.0	<.001
Community Factors by Zip Code			
Median household income, 2002 US \$	76 174	65 843	<.01
Population density, per square mile	2899	3386	<.01
% With some college education	80.7	76.5	<.001
% African American	21.3	28.4	<.01
Median home value, 2002 US \$	157 696	135 815	<.001
% Households with computer access in 2002	54.2	53.0	<.001

Table 2. Logistic Regression Analysis of Variables Associated With Immediate Breast Reconstruction Following Mastectomy for Breast Cancer in Maryland From 1995 to 2004

Variable	Odds Ratio (95% Confidence Interval)	P Value
Individual Factors		
African American vs white race/ethnicity	0.534 (0.474-0.601)	<.001
Age, every y increase	0.918 (0.915-0.921)	<.001
Community Factors by Zip Code		
Median household income, every \$10 000 increase in 2002 US \$	1.111 (1.060-1.164)	<.001
Population density, every 1000 increase per square mile	1.042 (1.027-1.056)	<.001
% With ≥ some college education, every 10% increase	1.303 (1.217-1.396)	<.001
% African American, every 10% increase	0.938 (0.917-0.959)	<.001
Median home value, every \$10 000 increase in 2002 US \$	0.973 (0.955-0.990)	.003
% Households with computer access in 2002, every 10% increase	0.962 (0.780-1.188)	.72

[16.6%] vs 3063 of 12 931 [23.7%]; $P < .001$), and from areas with higher median household incomes (\$76 174 vs \$65 843, $P < .01$), higher median home values (\$157 696 vs \$135 815, $P < .001$), lower population densities per square mile (2899 vs 3386, $P < .01$), higher percentages of community populations with at least some college education (80.7% vs 76.5%, $P < .001$), and lower percentages of African Americans in their home zip codes (21.3% vs 28.4%, $P < .01$) (**Table 1**).

We next performed multivariate analysis to include race/ethnicity (white or African American), age, mean household income, mean home value, population density, percentage of the population with a high school education or less, percentage of African Americans in the population, and percentage of households with a computer. We found that increasing income and increasing population density of the city in which the patient lives had statistically significant positive associations with the likelihood of immediate breast reconstruction. African American race/ethnicity, older age, increasing percentage of the patient's neighborhood with a high school education or less, and increasing African American composition of the patient's neighborhood had statistically significant negative associations. Overall, African Americans are 47% (odds ratio [OR], 0.534; 95% confidence interval [CI], 0.474-0.601) less likely to receive immediate reconstruction.

Older patient age was also significantly associated with a decreased likelihood of undergoing immediate reconstruction after mastectomy (OR, 0.918; 95% CI, 0.915-0.921 for each year increase in age). Community factors such the racial/ethnic composition of the neighborhood in which the patient lives, the educational levels of the patient's neighborhood, and the population density were independently associated with immediate reconstruction after mastectomy (**Table 2**). The percentage of households with a computer was statistically nonsignificant in the multivariate analysis.

An unusual finding was that increasing home value in the patient's community had a slightly negative impact on obtaining immediate breast reconstruction in multivariate analysis, although the reverse was seen in bivariate analysis. Nevertheless, the 95% CI approached unity, so the effect in multivariate analysis was small but statistically significant. Other community factors such as the percentage of households with computer access were not significantly associated with receiving immediate breast reconstruction.

COMMENT

This type of multilevel analysis combining individual patient factors with community factors has not been pre-

viously reported for a breast cancer cohort of this size, to our knowledge. Most clinical studies have focused on the characteristics of patients, perhaps because in clinical medicine we are used to focusing on the patient. However, factors beyond the patients such as community and neighborhood characteristics can also influence patient access to and attitude toward health care, but such issues traditionally have not been considered and have not been examined in clinical studies.

Five previous studies looked at other aspects of social demographics in large cohorts of patients with breast cancer and found racial/ethnic disparities as well. A large study²⁴ of breast cancer survivors (n=1957) from the metropolitan areas of Los Angeles, California, and Washington, DC, were sent self-report questionnaires that included several questions about physical and emotional outcomes. Of these patients, 42% had reconstruction. The authors found that women in the mastectomy with reconstruction group were younger than those in the lumpectomy or mastectomy-only groups. Patients who underwent immediate reconstruction also were more likely to have a partner, have a college education, be of white race/ethnicity, and have higher socioeconomic status. Similar findings were observed in several other studies.^{23,25-27} None of these studies noted the significant impact of the neighborhood in which the patient lives and how that can be an independent variable. Instead of (and in addition to) looking at the impact of the race/ethnicity and education status of patients, we also looked at the racial/ethnic composition and educational level of patients' home zip code areas, which have not been examined before, to our knowledge.

Our finding that higher population density is associated with higher rates of immediate reconstruction demonstrates that patients from urban neighborhoods undergo breast reconstruction more often. This may reflect the availability of plastic surgeons rather than characteristics of the individual patient. This is similar to the findings in a previous study²⁵ that reported a 4-fold variance in reconstruction between high-use vs low-use regions.

The somewhat unexpected finding of increasing home value having a negative association with obtaining immediate reconstruction may be explained by the general association between home value and older age. This finding also highlights the difference between income (as measured by household income) vs wealth (as measured by home value) on health care decisions and behaviors.

A limitation of our study may be our basic premise that immediate reconstruction is superior to mastectomy only or to delayed reconstruction. Our hypothesis began with the use of immediate reconstruction as a surrogate marker for optimal therapy and access to care among patients undergoing mastectomy. It is reasonable to believe that the costs are lower for immediate reconstruction vs delayed reconstruction.^{8,9} However, the direct and indirect costs to the patient and the hospital are higher when the patient has some type of reconstruction compared with mastectomy alone. Also, mastectomies that were performed as outpatient procedures were not captured in this database. Until 2001, Medicare re-

quired an inpatient stay for mastectomy reimbursement, a requirement that was adopted by other third-party payers. Therefore, we assumed that outpatient mastectomy represents a small fraction of the total number during this 10-year period and would not significantly affect our analysis.

Our premise can also be advanced as a "best practice" or indicator for quality in a pay-for-performance schema of reimbursement by third-party payers. In other words, offering breast reconstruction consultation with a plastic surgeon should be a quality indicator for primary care physicians and for surgical oncologists.

In terms of safety, various studies have shown that immediate reconstruction has low complication rates and unchanged recurrence rates. Mastectomy with immediate reconstruction was compared with modified radical mastectomy and was found to be similar for wound complications,²⁸ overall complications,²⁹ and cancer recurrence rates.^{11-15,18} On the other hand, in a prospective study³⁰ using patients from the Michigan Breast Reconstruction Outcome Study, the authors found that patients with immediate reconstructions had significantly higher complication rates than patients with delayed reconstruction. They concluded that the risk of a combined mastectomy-reconstruction procedure is probably lower than the cumulative complication rate for separate mastectomies and delayed reconstructions. Therefore, their study was not a call to end immediate reconstruction but rather to clarify that patients should know that there may be a higher complication rate when the mastectomy is combined with immediate reconstruction but less than the aggregate of 2 separate operations. Because the data in the study were collected prospectively, the complication rate will be higher than that reported in a retrospective study.

Other controversies that are evident when reviewing the literature on immediate breast reconstruction are quality of life^{2,24,26,31} and psychosocial factors³²⁻³⁹ and beg the question as to whether immediate reconstruction is truly better than delayed reconstruction or mastectomy only. Among patients who undergo reconstruction, the data are mixed about patient satisfaction for various types of procedures for their breast reconstruction.^{30,40,41} It is widely believed that a randomized trial would be unethical in which women do not decide their surgery but are randomly assigned to mastectomy, breast-conserving surgery, or mastectomy with reconstruction. To our knowledge, the only study⁷ that randomized patients to a mastectomy-only group vs an immediate breast reconstruction group was published in 1983. The authors found that immediate reconstruction reduced the psychiatric morbidity assessed 3 months after surgery, predominantly in women with unsatisfactory marriages. By 12 months, this difference was no longer evident. Nevertheless, several studies⁴⁻⁶ have been specifically designed to compare immediate reconstruction vs delayed reconstruction cohorts and have demonstrated that patients with immediate reconstruction have better outcomes in terms of psychosocial well-being.

CONCLUSIONS

In clinical medicine, we normally treat individuals, but this multilevel database analysis points to the need also to evaluate the community in which the patient lives. The racial/ethnic mix, mean income, and education level of the neighborhood and community are associated with breast cancer management outcomes. Prospective public health measures, including educational and informative programs, can be developed and implemented in the community to address these inequalities (particularly racial/ethnic disparities based on neighborhood) and to increase the likelihood that patients with breast cancer and mastectomy obtain immediate reconstruction.

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INVITED CRITIQUE

Rosson and colleagues have hypothesized that the frequency of immediate reconstruction following mastectomy is a surrogate for "optimal" breast cancer therapy. They report a disparity in the rate of immediate reconstruction that is related to age, race/ethnicity, education status, income, and community population density. Implicit in this is the assertion that lower-income African American women in more rural areas are not receiving the same quality of breast cancer treatment as higher-income urban white women. Many factors influence the decision for immediate reconstruction after mastectomy. Some of these are purely biologic; for instance, advanced primary cancers often require post-mastectomy chest wall radiation therapy, making immediate reconstruction less desirable. Other factors are related to the expediencies and biases of the patient, the expediencies and biases of the surgeon (often assimilated by the patient), and simple logistics such as local availability of expertise. Systematic inequities in our health care system must be identified and corrected. The difficulty arises, however, when the rate of immediate reconstruction is proposed as a surrogate for optimal therapy. Intelligent, affluent, and well-informed women facing a

mastectomy sometimes decide that the anticipated cosmetic benefits of reconstruction do not justify the pain, inconvenience, and risk involved. Do lower immediate reconstruction rates in poorer, more rural, primarily African American communities expose a systematic inequity, or do they simply identify a group of women for whom it is expedient to complete treatment as quickly as possible so that they can return to work? I am certain that both answers are correct. That every woman should have the option of breast conservation (if it is appropriate) or immediate reconstruction after mastectomy (if that is appropriate) cannot be debated. Because of the complexities involved in either of these decisions, neither is a suitable benchmark for "quality" of breast cancer care.

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