

# Evaluation of Racial Disparities in Postoperative Outcomes Following Breast Reconstruction at a Single Institution in Wisconsin

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## ABSTRACT

**Introduction:** Breast cancer is the most common cancer in women in Wisconsin. Evidence demonstrates that non-White racial minorities in the United States exhibit a higher mortality rate and more advanced or aggressive presentations of the disease than their White counterparts. Postmastectomy breast reconstruction remains essential to the treatment and recovery of these patients; however, racial disparities in the receipt of reconstruction are evident. This study evaluates the presence of racial disparities in postoperative outcomes of breast reconstruction at a single institution in Wisconsin.

**Methods:** An institutional review board-exempt retrospective study of postoperative outcomes was performed using a single institution's National Surgical Quality Improvement Program Registry to identify patients who underwent autologous or prosthesis-based breast reconstruction following mastectomy. Patient demographic, preoperative, operative, and postoperative variables were recorded. Postoperative outcomes in relation to self-reported race were evaluated using univariate analysis and propensity score matching.

**Results:** A total of 1,140 patients were included (1,092 White vs 48 non-White), with fewer non-White patients undergoing reconstruction. Patients of non-White race demonstrated a higher incidence of morbid obesity (4.4% White vs 12.5% non-White,  $P=0.010$ ) and bleeding disorders (0.3% White vs 4.2% non-White,  $P<0.001$ ). No association between self-reported race and postoperative complication was found.

**Conclusion:** This study did not reveal racial disparities in postoperative outcomes of breast reconstruction at a single institution in Wisconsin; however, non-White patients were less likely to undergo reconstruction. Further research into the underlying causes of unequal access to care, influence of insurance, effect of structural racism, and impact of physician- and patient-associated factors is warranted.

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## INTRODUCTION

With an estimated 276,450 new diagnoses in the United States in 2020 alone, breast cancer is one of the most common forms of cancer in women, second only to select skin cancers.<sup>1</sup> Although the incidence of breast cancer is similar for non-Hispanic Black and White women, Black women have a 40% higher mortality rate than their White counterparts.<sup>1,2</sup> Other non-White minority populations share this higher mortality risk, as well as an increased likelihood of more advanced or aggressive presentations of breast cancer at the time of diagnosis.<sup>1-3</sup> It is hypothesized that a lack of health insurance coverage in these populations serves as a barrier to preventive breast cancer screening, leading to disparities in early detection.<sup>1,4</sup> Such differences in outcomes are only one of the many examples of racial and ethnic disparities in the clinical setting, which may be perpetuated by racial inequality as a product of governmental laws, the economic system, and societal norms defined as structural racism.<sup>5</sup>

Unfortunately, racial and ethnic disparities in health care delivery and outcomes witnessed at the national level are evident in Wisconsin as well. With an incidence rate of 130.6 per 100,000 from 2012 through 2016, Wisconsin surpasses the national average incidence rate for breast cancer in women of 125.2 per 100,000.<sup>1</sup> The state was reported to have performed worse than the national average in 22 of 27 measures of disparity for Black and Hispanic populations and earned a D in overall health disparities in the 2016 Health

of Wisconsin Report Card.<sup>6</sup> Further, the Wisconsin Collaborative for Healthcare Quality found substantial disparities in breast cancer screening for American Indian or Alaska Natives and Asian or Pacific Islanders, as well as individuals who are enrolled in Medicaid or are uninsured.<sup>6</sup> These poignant findings have driven recent reform, prompting an Executive Order by Wisconsin's Governor Tony Evers in 2019 to diminish disparities statewide by 2030.<sup>7</sup>

Further, breast reconstruction plays a critical role in the management and recovery of patients who have undergone mastectomy. Postmastectomy breast reconstruction has been shown to improve quality of life in patients, eliciting both physical and psychological benefits.<sup>4,8</sup> In 2019, approximately 107,238 reconstructive breast procedures were performed in the US, accounting for a 36% increase in procedural volume since 2000.<sup>9</sup> In part, the Women's Health and Cancer Rights Act of 1998 has contributed to this increase, mandating insurance coverage for reconstructive breast surgeries.<sup>10</sup> Despite this increase, many women across the US are unaware of breast reconstruction options, especially in patient populations considered to be racial and ethnic minorities, highlighting a fundamental source of disparities.<sup>4,11</sup> To aid in alleviating the inequalities presented by disparities in breast reconstruction, a directive to increase awareness of reconstructive options in patients of racial and ethnic minorities groups was implemented through the Breast Cancer Patient Education Act of 2015.<sup>12</sup> Nonetheless, it has been demonstrated that White women exhibit higher rates of reconstruction than minority women, as only 28% of reconstructive breast procedures performed in 2019 were for patients who identify as a racial or ethnic minority.<sup>4,8,9</sup> This highlights attempts to alleviate the influence of structural racism; however, additional efforts need to be made to elicit notable effects on the reversal of structural racism within the health care system.

It is clear that racial and ethnic disparities exist in breast cancer screening, diagnosis, and access to breast reconstruction; however, much less is known about the role these disparities play in the outcomes of patients who undergo reconstructive breast surgery. To elucidate this, Blankensteijn et al<sup>13</sup> investigated the impact of race on outcomes of breast reconstruction on a national level using patient data from the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP). This study did not find an association between race and occurrence of postoperative complications; however, it is unclear whether these trends vary by state or county. Given the evident disparities in the overall outcomes of breast cancer patients in Wisconsin, investigation into the presence of disparities in reconstructive outcomes is warranted. Therefore, this study used patient data from the University of Wisconsin Hospital and Clinics Authority Adult NSQIP Registry to examine racial disparities in postoperative outcomes of reconstructive breast surgery in Wisconsin.

## METHODS

### Data Collection

This was an institutional review board-exempt retrospective study that utilized a single institution's (University of Wisconsin – Madison) Adult NSQIP Registry. The ACS-NSQIP is a source of nearly 200 prospectively documented demographic, preoperative, operative, and 30-day postoperative variables.<sup>14</sup> Data are collected for randomly assigned surgical cases and recorded by dedicated statisticians in a HIPAA-compliant manner.

Patient data were collected for reconstructive breast surgery cases performed at our institution between July 2009 and June 2020. Data acquisition began mid-year in 2009 as this is when University of Wisconsin Hospital and Clinics Authority Adult NSQIP Registry began. Cases with the following primary current procedural terminology (CPT) codes corresponded to delayed autologous reconstruction: 19361, 19364, 19366, 19367, 19368, and 19369. Cases with the following primary CPT codes corresponded to delayed prosthesis-based reconstruction: 11970, 19325, 19340, 19342, 19357. Lastly, cases with the following primary CPT codes, along with a previously indicated CPT code listed as a secondary procedure, were appropriately scored as either immediate autologous reconstruction or immediate prosthesis-based reconstruction: 19120, 19125, 19301, 19302, 19303, 19304, 19305, 19306, and 19307.

### Variables of Interest

Recorded variables included demographic, preoperative, operative, and postoperative variables. Demographic information included patient self-reported race (White, Black or African American, Asian, Native Hawaiian or Other Pacific Islander, American Indian or Alaska Native, and unknown), self-reported ethnicity (Hispanic and non-Hispanic), age, and sex. Preoperative variables included smoking status, body mass index, American Society of Anesthesiologists Class, diabetes mellitus, history of congestive heart failure, hypertension requiring medication, renal disease, chronic steroid use, bleeding disorder, history of chronic obstructive pulmonary disease, malnourishment, and presence of metastatic disease. Postoperative variables included readmission related to breast reconstruction, reoperation related to breast reconstruction, incidence of any complication, incidence of minor complication (urinary tract infection, superficial surgical site infection, pneumonia, and unplanned readmission), incidence of severe complication (sepsis, septic shock, myocardial infarction, cardiac arrest, deep wound infection, deep surgical site infection, organ/space surgical site infection, wound dehiscence, pulmonary embolism, deep venous thrombosis, progressive renal insufficiency, renal failure, stroke, transfusion, unplanned reintubation, failure to wean off ventilator, death, and unplanned reoperation), and death. Data manipulations and statistical analyses were conducted in R 3.6.0 (R Foundation, Vienna, Austria). An a priori power analysis determined a minimum number of 32 patients to detect

**Table 1.** Univariate Analysis (chi-square and Fisher exact test) of the Association Between Race and Preoperative Covariates

Covariate	Whole Cohort			Propensity Score Matched Groups		
	Self-Identified White Race (N=1,092) n (%)	Self-Identified Non-White Race (N=48) n (%)	P value	Self-Identified White Race (N=144) n (%)	Self-Identified Non-White Race (N=48) n (%)	P value
Surgery			0.870 <sup>a</sup>			1.000 <sup>a</sup>
Delayed autologous reconstruction	336 (30.8)	16 (33.3)		48 (33.3)	16 (33.3)	
Immediate autologous reconstruction	3 (0.3)	0 (0.0)		0 (0.0)	0 (0.0)	
Immediate prosthesis-based reconstruction	12 (1.1)	0 (0.0)		0 (0.0)	0 (0.0)	
Delayed prosthesis-based reconstruction	741 (67.9)	32 (66.7)		96 (66.7)	32 (66.7)	
Age > 60 years	185 (16.9)	4 (8.3)	0.117 <sup>a</sup>	7 (4.9)	4 (8.3)	0.370 <sup>a</sup>
Hispanic ethnicity	20 (1.8)	1 (2.1)	0.899 <sup>a</sup>	3 (2.1)	1 (2.1)	1.000 <sup>a</sup>
ASA Class > 2	0 (0.0)	0 (0.0)	NA	0 (0.0)	0 (0.0)	NA
Current tobacco use	82 (7.5)	6 (12.5)	0.205	11 (7.6)	6 (12.5)	0.305
Morbid obesity	48 (4.4)	6 (12.5)	<b>0.010</b>	21 (14.6)	6 (12.5)	0.719
Diabetes	40 (3.7)	1 (2.1)	0.565 <sup>a</sup>	8 (5.6)	1 (2.1)	0.324 <sup>a</sup>
History of congestive heart failure	0 (0.0)	0 (0.0)	NA	0 (0.0)	0 (0.0)	NA
Medicated hypertension	178 (16.3)	11 (22.9)	0.228	40 (27.8)	11 (22.9)	0.509
Renal disease	0 (0.0)	0 (0.0)	NA	0 (0.0)	0 (0.0)	NA
Chronic steroid use	19 (1.7)	2 (4.2)	0.221 <sup>a</sup>	5 (3.5)	2 (4.2)	0.824 <sup>a</sup>
Bleeding disorder	3 (0.3)	2 (4.2)	<b>&lt;0.001<sup>a</sup></b>	1 (0.7)	2 (4.2)	0.093 <sup>a</sup>
History of COPD	3 (0.3)	0 (0.0)	0.716	0 (0.0)	0 (0.0)	NA
Malnourishment	1 (0.1)	0 (0.0)	0.834	0 (0.0)	0 (0.0)	NA
Metastatic disease	4 (0.4)	0 (0.0)	0.674	0 (0.0)	0 (0.0)	NA

Abbreviations: ASA, American Society of Anesthesiologists; COPD, chronic obstructive pulmonary disease. Boldface indicates significance; <sup>a</sup>indicates use of Fisher exact test.

a large effect size. Given the small number of Black or African American, Asian, Native Hawaiian or Other Pacific Islander, and American Indian or Alaska Native patients, all comparative analyses were performed with groupings of White versus non-White patients.

### Univariate Analysis

Significance was set at  $\alpha = 0.05$  for all analyses. Descriptive statistics were conducted to characterize the patient cohort, and chi-square and Fisher exact tests were implemented to identify associations between patient self-reported race and preoperative variables (Table 1). Fisher exact tests were utilized in cases in which the variable of interest was observed in fewer than 5 patients, otherwise chi-square tests were used. Chi-square tests were again implemented to identify associations between patient self-reported race and the incidence of postoperative complications (Table 2).

### Propensity Score Matching

Propensity score matching was applied to elucidate the independent association of non-White self-reported race on the incidence of various postoperative complications. The MatchIt package (R Foundation, Vienna, Austria)<sup>15</sup> was utilized to develop a 3:1 greedy matching algorithm<sup>16</sup> (3 patients of White self-reported race matched to each patient of non-White self-reported race) that

included all preoperative variables of interest. Exact matching was implemented for surgical procedures to control for any differences in postoperative complications that might be associated with different types of breast reconstruction. Chi-square and Fisher exact tests were conducted to verify that the propensity score matched groups were adequately balanced (Table 1). Finally, chi-square tests were performed to assess for associations between patient self-reported race and the incidence of postoperative outcome in the propensity score matched groups (Table 2).

### RESULTS

Retrospective review identified 1,436 patients who underwent procedures with primary CPT codes corresponding to either breast reconstruction or mastectomy between July 2009 and June 2020. Following the exclusion of 212 patients who received mastectomy without reconstruction, 77 patients of unknown race, and 7 nonfemale patients, 1,140 patients met the inclusion criteria. The self-reported race of the cohort was as follows: 1,092 White patients, 29 Black or African American patients, 7 American Indian or Alaska Native patients, 10 Asian patients, and 2 Native Hawaiian or Other Pacific Islander patients. Following the creation of propensity score matched groups, 33 (17.2%) patients experienced any postoperative complication, 21 (10.9%) patients experienced a minor postoperative compli-

**Table 2.** Univariate Analysis (chi-square test) of the Association Between Race and Postoperative Complication

Postoperative Complication	Whole Cohort			Propensity Score Matched Groups		
	Self-Identified White Race (N=1,092) n (%)	Self-Identified Non-White Race (N=48) n (%)	P value	Self-Identified White Race (N=144) n (%)	Self-Identified Non-White Race (N=48) n (%)	P value
Any	146 (13.4)	9 (18.8)	0.287	24 (16.7)	9 (18.8)	0.740
Minor	93 (8.5)	5 (10.4)	0.646	16 (11.1)	5 (10.4)	0.894
Severe	113 (10.3)	7 (14.6)	0.349	17 (11.8)	7 (14.6)	0.614
Unplanned readmission related to breast reconstruction	55 (5.0)	3 (6.2)	0.708	10 (6.9)	3 (6.2)	0.868
Unplanned reoperation related to breast reconstruction	96 (8.8)	7 (14.6)	0.171	17 (11.8)	7 (14.6)	0.614

Propensity score matched groups were generated to determine the independent association of non-White race and the incidence of postoperative complications. Significance indicated by a P value  $\leq 0.05$ .

complication, 24 (12.5%) patients experienced a severe postoperative complication, 13 (6.8%) patients experienced an unplanned readmission for reasons related to their breast reconstruction, and 24 (12.5%) patients experienced an unplanned reoperation for reasons related to their breast reconstruction. No patients in this cohort died within 30 days of surgery.

On univariate analysis (chi-square and Fisher exact tests), non-White race was associated with morbid obesity (4.4% of White race vs 12.5% of non-White race,  $P=0.010$ ) and having a bleeding disorder (0.3% of White race vs 4.2% of non-White race,  $P<0.001$ ) (Table 1). The cohort demonstrated no association between patient self-reported race and incidence of postoperative complication on univariate analysis (Table 2).

Following the generation of propensity score matched groups, there were 144 patients of White race and 48 patients of non-White race. Chi-square and Fisher exact tests verified that these groups were balanced with respect to preoperative covariates (Table 1). Upon assessment of the incidence of postoperative complications, the balanced cohort showed no association between patient self-reported race and incidence of postoperative complications.

## DISCUSSION

The abundant, yet nonhomogeneous, evidence suggesting the existence of racial disparities in postmastectomy breast reconstruction at the national level prompted investigation into such disparities in postoperative outcomes of reconstructive breast surgery in Wisconsin. This study utilized a single institution's NSQIP Registry to identify 1,140 patients who underwent breast reconstruction following mastectomy from 2009 to 2020. Although patients of non-White race demonstrated a higher incidence of the preoperative covariates of morbid obesity and existence of a bleeding disorder, no association was found between patient race and incidence of postoperative complication on univariate analysis and propensity score matching. Our analysis aligns with those of Blankensteijn et al<sup>13</sup> and Butler et al,<sup>17</sup> which found no association between patient race and postoperative outcomes. However,

a single institution study by Mets et al<sup>3</sup> found persistent racial and ethnic disparities in surgical outcomes in breast cancer, which may indicate significant variation in disparities based on geographic location. Notably, there were far fewer non-White patients who underwent breast reconstruction at our institution than White patients (4.2% vs 95.8%). Approximately 15% and 7% of the Dane County population is of non-Hispanic, non-White race and Hispanic ethnicity, respectively.<sup>18</sup> Our results demonstrate that only 4.2% and 1.8% of patients who underwent breast reconstruction at our institution were of non-Hispanic, non-White race and Hispanic ethnicity, respectively. Overall, the lack of evident racial disparities may indicate the provision of equitable care for all patients once in our institution's system; however, the discrepancy in comparative patient demographics may elude to potential disparities in access to care in Dane County, Wisconsin and the surrounding areas.

Insurance coverage and socioeconomic status have been described as barriers in access to care; however, studies have demonstrated a persistence of disparities even after controlling for insurance status and income.<sup>4,13,19,20</sup> Federal mandates, such as the Patient Protection and Affordable Care Act (ACA),<sup>21</sup> have been implemented to expand the provision of health insurance to the public and facilitate access to care. Specific to Dane County, the enactment of the ACA reportedly allowed thousands of residents to gain health care coverage, and as of 2019, only 4.9% of individuals under age 65 remain uninsured,<sup>22</sup> which is considerably lower than that of the state and national percentages of 6.9% and 10.9%, respectively.<sup>23</sup> Despite these efforts, studies demonstrate that patients with private insurance coverage are more than twice as likely to undergo breast reconstruction than those who are uninsured or enrolled in public insurance.<sup>4</sup> Similarly, non-White minority patients comprise a higher proportion of patients with public or lack of insurance, which promotes a predisposed limitation in access to plastic surgeons and recommendations for reconstruction.<sup>4,19</sup> This is reflective of the Dane County population, as Hispanics are disproportionately represented in the percentage of those uninsured.<sup>22</sup>

Further, the impact of income and receipt of breast reconstruction have been documented. A survey by Rubin et al<sup>24</sup> found that 75% of Black women who underwent breast reconstruction following mastectomy had an annual income of over \$50,000. In those with an annual income of less than \$20,000, only 22% underwent reconstruction.<sup>24</sup> In addition, Black women in the study who underwent reconstruction reported that they might have elected to forgo the procedure if they had to pay out of pocket.<sup>24</sup> In Dane County, the median household income is approximately \$64,773, which is higher than state and national values; however, the median income for those of Black race is \$30,000.<sup>22</sup> As a result, lower rates of reconstruction for non-White minority patients may be perpetuated by the high cost of procedures and consideration of lost days of work, causing a significant impact on financial stability. Such instance may be a product of residential segregation, which is deemed a fundamental component of structural racism as it shapes access to care and is accompanied by socioeconomic disadvantage, most often for those of Black race.<sup>5</sup> Therefore, these findings may highlight the inability of insurance and income alone to eliminate racial and ethnic disparities in access to care; thus, evaluation of other contributing factors, such as structural racism, is imperative.

Numerous studies have proposed alternative confounding variables for the existence of disparities in rates of breast reconstruction, citing physician- and patient-associated factors. Studies suggest that non-White patients are less likely to receive breast reconstruction compared to their White counterparts, noting the existence of preexisting comorbidities and suboptimal health status as a source of concern expressed by some surgeons.<sup>3,13,20</sup> However, the validity of this concern is challenged by evidence supporting equivalent postoperative outcomes for White and non-White patients, even with the presentation of a higher preoperative comorbidity profile by non-White patients.<sup>13,17</sup> Although this may be the case, Tseng et al<sup>25</sup> found that African American women were less likely to accept a referral to a plastic surgeon and reconstruction, even when offered, highlighting the potential for rates of reconstruction to be confounded by personal preference. It has been reported that concern for the insertion of a foreign body in the form of an implant and systemic distrust of the medical field are exhibited by non-White patients,<sup>19,20,24</sup> along with cultural differences in race-related emphasis placed on the breast as a measure of physical attraction.<sup>13,19,20,24</sup> Despite this, Berlin et al<sup>8</sup> found that Black women did experience better psychosocial and sexual well-being post reconstruction than their White counterparts, indicating the benefits of postmastectomy breast reconstruction remains evident in this population. Further, Black women were more likely to report dissatisfaction with the decision-making process, regardless of receipt of reconstruction;<sup>20</sup> thus, educating patient populations about postmastectomy reconstructive options is imperative. To achieve this in Wisconsin, the Cancer Health Disparities Initiative program at the University of Wisconsin Carbone Cancer

Center has worked to provide patient education and community outreach to underserved populations; however, continued efforts at the county, state, and national levels are critical to the narrowing of the disparities surrounding breast cancer treatment and reconstruction.

### Limitations

Our study is not without limitations. This is a retrospective review of a single institution; thus, the analysis is most reflective of Dane County and the surrounding catchment area and may not be generalizable to the state of Wisconsin as a whole. It is estimated that approximately 86% of Wisconsin's African American population resides in the cities of Kenosha, Beloit, Racine, and Milwaukee; therefore, Dane County may not be indicative of the racial disparities in breast reconstruction outcomes for the state of Wisconsin. It is also important to note that the NSQIP Registry used to obtain patient information in this study only monitors patient outcomes 30 days post-operation. Thus, it is possible that these patients developed complications after the 30-day period, indicating that the health consequences of systemic racism are chronic and may be more insidious in onset. Further, given the objective nature of the NSQIP Registry, it is unknown if there are disparities in patient-reported satisfaction. The patient data obtained by our institution's NSQIP Registry are also limited by the lack of patients' insurance status. Insurance status is only newly available to the NSQIP database and was not available for our queried data set, and thus warrants further investigation in future studies. Finally, as a large portion of the patient population was excluded, the diminished cohort size may contribute to an under- or over-estimation of racial disparities in Wisconsin. As this is a preliminary investigation of racial disparities in postoperative outcomes of breast reconstruction, our future studies aim to broaden the scope of research to include analyses to evaluate variables such as stage of cancer, insurance status, type of reconstruction, and surgical techniques.

### CONCLUSION

This study aimed to identify potential racial disparities in postoperative outcomes of breast reconstruction at a single institution in Wisconsin. Our results did not indicate an association between race and incidence of postoperative complication at our institution, used as a representation of the state of Wisconsin. While these gross findings of equitable postoperative complication rates in patients undergoing reconstruction within our health care system are evident, further investigation into the cause for the lack of patients of non-White race undergoing reconstruction at our institution is warranted. Ultimately, additional research is necessary to fully understand the underlying causes of inequities in access to care, influence of insurance and income, effect of structural racism, and impact of physician- and patient-associated considerations.

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