

Area Deprivation Index is Associated with Variation in Quality of Life and Psychosocial Well-being Following Breast Cancer Surgery

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Abstract

Purpose: Neighborhood-level factors have been shown to influence surgical outcomes through material deprivation, psychosocial mechanisms, health behaviors, and access to resources. To date, no study has been conducted to examine the relationship between area-level deprivation (ADI) and post-mastectomy outcomes.

Methods: A cross-sectional survey of all adult female breast cancer patients who underwent lumpectomy or mastectomy between January 2018 to June 2019. Patient-specific demographics, clinical history and ADI information were abstracted and correlated with post-operative global- (SF-12) and condition-specific (Breast-Q) quality-of-life performance via multivariable regression. Patients were classified into three groups based on their ADI scores: 0–39 (prosperous/comfortable), 40–59 (mid-tier), and 60–100 (at risk/distressed).

Results: A total of 564 consecutive patients were identified; mostly white (75%) with a mean age of 60.2 ± 12.4 , mean body mass index (BMI) of 28.8 ± 7.1 , mean Charlson Comorbidity Index of 3.5 ± 2.0 , and mean ADI of 42.3 ± 25.7 . Minority patients and those with high BMI were more likely to reside in highly-deprived neighborhoods ($p=0.003$ and $p<0.001$). In adjusted models, Patients at risk/distressed had significantly lower mean SF-12 physical (44.9 [95%CI, 43.8-46.0] vs. 44.9 [95%CI, 43.7-46.1] vs. 46.3 [95%CI, 45.3-47.3], $p=0.03$) and BREAST-Q psychosocial well-being scores (63.5 [95%CI, 59.32-67.8] vs. 69.3 [95%CI, 65.1-73.6] vs. 69.7 [95%CI, 66.4-73.1], $p=0.01$) than the mid-tier and prosperous/comfortable groups.

Conclusions: Patients residing in deprived neighborhoods were more likely to have worse psychological well-being and quality of life. ADI should be incorporated in the shared-decision making process and perioperative counselling to engender value-based and personalized care, especially for vulnerable populations.

Introduction

Breast cancer health disparities have persisted in the United States (US), despite significant advancements in cancer therapy, screening, diagnosis, and prevention. Recently, there has been a growing recognition that socioeconomic factors have a significant impact on health, quality of life, and mortality. [1, 2] Previous studies have demonstrated that socioeconomic risk factors may negatively impact surgical outcomes, with higher adjusted rates of mortality, surgical complications and readmission rates. [3-9] Of note, the overwhelming majority of these studies examining the impact of socioeconomic status on surgical outcomes have leveraged proxies such as age, gender, race/ethnicity, insurance status, and income.

Broadly speaking, the social determinants of health (SDoH) denote the conditions within which individuals grow up, live, work and age that impact their health status.[10] Examples include food insecurity, poor transportation, built environment, and housing instability.[11-13] This relationship to

health outcomes is believed to be mediated via several mechanisms such as material deprivation, psychosocial stressors, maladaptive health behaviors, and limited access to resources.[14] As US health systems increasingly adopt value-based care payment models to incentivize lower spending and improved clinical outcomes, payers and hospital administrators have acknowledged that accounting for the SDoH must be a key element of these efforts.[15, 16]

The area-deprivation index (ADI) is a validated composite measure of SDoH that offers policy-makers and the health services research community a more holistic view, relative to aforementioned proxies like race, education level and insurance status, of the drivers of health outcomes and disparities. Prior studies have shown that patients living in more deprived neighborhoods, as measured by ADI, had higher overall mortality and worse surgical outcomes.[7, 17-21] To date, there is a paucity of literature examining the relationship between ADI and postoperative outcomes in breast cancer patients despite the high annual incidence and availability of condition-specific patient reported outcome (PRO) instruments like Breast-Q. In the present study, we evaluate the association between ADI and quality-of-life (QOL) after breast cancer surgery. We hypothesize that patients from more deprived neighborhoods will report lower post-operative QOL and psychosocial well-being, and that certain demographic characteristics are differentially associated with ADI.

Methods

Study Design and Participants

This is a secondary analysis of a previously described single-institution, cross-sectional study of all patients who underwent lumpectomy or mastectomy, with or without reconstruction at the University of Texas MD Anderson Cancer Center over an 18-month period (January 2018 to June 2019).[22, 23] Adult (> 18 years) female who underwent surgery for a diagnosis of breast cancer, genetic predisposition (e.g. BRCA, Li-Fraumeni syndrome), or ductal carcinoma in-situ were identified and administered the BREAST-Q[24] and 12-Item Short Form Health Survey (SF-12).[25] The BREAST-Q is a validated condition-specific patient-reported outcome measure with procedure-specific modules for assessing quality of life and satisfaction following breast surgery.[24] Items are converted to an overall score ranging from 0 to 100, with a lower score indicating a poorer outcome. The SF-12 is a global health patient-reported outcome measure that can be used as a utility measure.[26] It is a variation of the SF-36, with scores ranging from 0 to 100 for two domains, and lower scores indicating lower quality of life. It is most effective when applied to overall physical and mental health.[27] Male patients, international patients seeking treatment, those with incomplete PRO responses or missing home address information were excluded from the analytic sample. The MD Anderson Cancer Center's Institutional Review Board (IRB) approved this study, and all respondents provided consent as part of the questionnaire to have their answers linked to data obtained from our electronic medical record (EPIC; Epic Systems Corp., Verona, Wis.)

Survey

Our survey administration workflow has been previously described.[22, 28] In brief, the survey was delivered via email in English, with three electronic reminders sent in the event of a nonresponse. No monetary or in-kind incentive were provided to participants. Given the sample frame and concerns about undue survey burden by the IRB committee, a non-responder analysis was not pursued. Responses were recorded in Research Electronic Data Capture (REDCap) and linked to corresponding electronic medical record for the following patient-level information: age, race/ethnicity, body mass index (BMI), insurance type, cancer stage, ablative surgery type, laterality (unilateral or bilateral), reconstruction sub-type (autologous, implant-based), reconstruction timing (immediate or delayed), and receipt of chemotherapy and/or radiotherapy.

ADI Construction

Similar to published methods, the permanent address on file for each patient was geocoded and the associated census block group was then linked to a national ADI percentile score.[29] National and not state-level percentile scores were used to enhance the generalizability of our results. The ADI stratifies geographic areas at a granular block group level utilizing 17 American Community Survey variables from the US Census, such as poverty, housing, employment, and education.[11, 20, 30] Scores range from 1 to 100, with higher scores indicating greater disadvantage.[20, 30] To facilitate our analysis, patients were categorized using the following previously described criteria[18, 31, 32]: 1) 0–39 (prosperous/comfortable), 40–59 (mid-tier), and 60–100 (at risk/distressed).

Outcomes

Our primary aim is to investigate the independent relationship between ADI and post-operative condition-specific (BREAST-Q) and global (SF-12) QOL. To ensure uniformity throughout our patient sample, we selected one quality of life domain (psychosocial well-being) and two satisfaction domains (breasts and surgeon) from the BREAST-Q instrument. i.e. those who did and did not undergo breast reconstruction received similar surveys.

Statistical Analysis

Descriptive statistics and frequency/percentages were used to present the continuous and categorical variables. Chi-squared or Fisher's exact tests were used to compare the percentage of patients' characteristic among ADI groups. Continuous variables were compared using the two-sample t-test or ANOVA if data had normal distribution. Otherwise, Wilcoxon rank sum test or Kruskal Wallis test were used alternatively. Missing values were imputed using normal distribution, Bernoulli distribution and multinomial distribution. BREAST-Q and SF-12 were measured at least 60 days after surgery. Univariate and multiple linear regression models were used to assess the effect of ADI and patient's characteristic on BREAST-Q/SF-12. Residual plots were used for model diagnosis. Adjusted least squares means were estimated for PROs in each ADI category, controlling for other risk factors. Parsimonious multiple regression models were fit using the stepwise selection method with least Akaike information criterion (AIC). All statistical tests were 2-sided and p-values less than 0.05 were considered statistically

significant. All analyses were performed in SAS Enterprise Guide version 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

Patient Demographics and Characteristics

Overall, 2,293 consecutive patients were identified, with 647 surveys returned (28.2% response rate). Those who were male, did not have breast cancer, could not be linked to clinical records, or did not complete the BREAST-Q or SF-12 questionnaires were excluded from the study. Patients who satisfied these criteria ($n = 564$, 87%) comprised the final analytic sample, and 361 were found to have had breast reconstruction (64%).

Patients had a mean age of 60.2 ± 12.4 , mean BMI of 28.8 ± 7.1 , mean Charlson Comorbidity Index (CCI) of 3.5 ± 2.0 . The majority of patients were white (74.5%), had early stage cancer (0-2; 84%), managed with lumpectomy (56%), radiation (66%), and hormonal therapy (65%). Most patients (55.5%) did not receive chemotherapy. Among reconstruction recipients, 63% had immediate reconstruction, and the most common reconstruction subtype was oncoplastic (50%), followed by expander-based reconstruction (38%). The mean ADI was 42.3 ± 25.7 . Using the 3-category ADI, most patients (49.2%) were prosperous/comfortable, 23.2% were mid-tier, and 27.5% were at risk/distressed.

Area Deprivation Index and Patient Characteristics

Patients who were at risk/distressed had significantly higher BMI than those who were in the mid-tier and prosperous/comfortable groups (30.52 ± 6.4 vs. 29.26 ± 8.11 vs. 27.73 ± 5.72 , $p < 0.001$) (**Table 1**). While the overall proportion of ethnic/racial minorities was low (25.5%), minorities made up significantly higher proportion of patients with high ADI. We found a significantly higher proportion of African American patients in the at risk/distressed groups than were in the mid-tier and prosperous/comfortable groups (41% vs. 25% vs. 34%, $p = 0.003$). Similarly, we found that the at risk/distressed groups had a significantly higher proportion of Hispanic patients than the mid-tier and prosperous/comfortable groups (48% vs. 17% vs. 35%, $p = 0.003$). On the other hand, we found a significantly higher proportion of white patients in prosperous/comfortable groups than those who were in the mid-tier at risk/distressed groups (53% vs. 24% vs. 23%, $p = 0.003$).

Area Deprivation Index and PROs

Overall, the mean BREAST-Q psychosocial well-being score was 71.7 ± 20.4 , mean satisfaction with breasts score was 68.3 ± 20.7 , and mean satisfaction with surgeon score was 92.4 ± 14.9 . The mean SF-12 physical component was 46.4 ± 6.2 , and the mean mental score was 45.6 ± 6.0 . Univariate models were used to examine the relationship between ADI, BREAST-Q, and SF-12 (**Table 2**). Patients who were at risk/distressed had significantly lower mean SF-12 physical (44.87 ± 6.67 vs. 45.51 ± 6.39 vs. 47.56 ± 5.54 , $p < 0.001$) and BREAST-Q psychosocial well-being scores (65.49 ± 18.8 vs. 72.2 ± 21 vs. 74.48 ± 20.35 , $p < 0.001$) than those who were in the mid-tier and prosperous/comfortable groups.

After controlling for age, race, BMI, CCI, type of mastectomy, complications and length of stay on multivariable analyses, ADI remained associated with BREAST-Q and SF-12 (**Table 3**). Patients who were at risk/distressed had significantly lower adjusted mean SF-12 physical (44.9 [95%CI, 43.8-46.0] vs. 44.9 [95%CI, 43.7-46.1] vs. 46.3 [95%CI, 45.3-47.3], p=0.03) and BREAST-Q psychosocial well-being scores (63.5 [95%CI, 59.32-67.8] vs. 69.3 [95%CI, 65.1-73.6] vs. 69.7 [95%CI, 66.4-73.1], p=0.01) than those who were in the mid-tier and prosperous/comfortable groups.

Discussion

This study sought to illuminate the relationship between ADI and QOL performance following ablative surgery for breast cancer. After adjusting for competing risk factors, we found that patients from high ADI neighborhoods had significantly lower BREAST-Q psychosocial well-being and SF-12 global physical quality of life. In addition, our unadjusted results suggest that residents of areas with high economic deprivation were likely to have a high BMI and a racial background that was Black or Hispanic. This latter finding is consistent with a larger body of work that has documented racialized economic and residential segregation, upheld by sustained divestment, predatory lending policies, limited educational opportunities, and structural racism.[33, 34] Collectively, these results also suggest that the assertion “*zip codes matter more than genetic code*”[35, 36] has some credence with respect to surgical outcomes (clinical and PROs). Therefore, initiatives designed to improve surgical outcomes must address *both* patient- and community-level factors.

Neighborhoods are complex environments with a variety of economic, social, and physical characteristics that have a significant impact on the health of the residing individual.[37] According to some estimates, the SDoH contribute > 50% of the modifiable factors that drive health outcomes.[38, 39] A recent paper by Hyer et al documented a higher risk of adverse outcomes and 20% lower odds of attaining “textbook outcomes” among individuals with high social vulnerability following major cancer surgery.[21] Therefore, contextualizing the association between the SDoH, as represented by area-level deprivation, and health outcomes in cancer care is of great interest to payers, physicians, patients, and policymakers. In light of recently signaled Medicare interest in utilizing PROs and functional outcomes as markers of healthcare quality, our aforementioned results also enrich the policy salience of the extant literature.[40]

There are several conceivable explanations for our finding, including the premise that patients from vulnerable neighborhoods are more likely to face cumulative lifelong stress (i.e. allostatic load), such as anxiety for personal safety, chronic food and housing insecurity, and exposure to violence, the enduring impact of which has implications for QoL outcomes.[19, 37] Additionally, financial toxicity, which is the economic burden of treatment-associated costs on patients and their families, has been strongly correlated with worse post-operative condition-specific and global QOL in breast cancer patients.[23, 41] This provides an additional explanatory framework for our findings as ADI is likely to be highly correlative with financial toxicity. Lastly, patients from vulnerable neighborhoods have been associated with low health literacy and reduced access to physicians, resulting in differences in health maintenance and knowledge gaps.[42, 43] This is important because the surgical management of breast cancer is

preference-sensitive with different risks, complications and benefits associated with each choice i.e. lumpectomy, mastectomy, and receipt of reconstruction. These knowledge gaps not only undermine the quality of patient decision-making, but they also contribute to a discrepancy between pre-operative expectations and post-operative outcomes, which subsequently engenders poor QoL performance.[44]

Previous studies have also shown that unrealistic patient expectations predict adverse outcomes, such as a worsening in functional status and health-related quality of life.[45] Unrealistic expectations, for example, may cause patients to become easily discouraged with postoperative therapy and nonadherent to postoperative recommendations. Patients with low expectations may also lack the motivation needed to continue with therapy, resulting in patients not receiving the full benefit of breast cancer surgery. Therefore, measures should be taken to better understand what patients in deprived neighborhoods expect after breast cancer surgery, so that services may be provided to fulfill these needs and ensure alignment between patients and breast surgeons as they jointly work toward the same goals.

Although beyond our study scope and the expertise of our research team, we hope that our results serve to catalyze efforts to operationalize the assessment of the SDoH in breast cancer care encounters. Pursuant to this, ADI can be used as a scalable tool for identifying populations at high risk of poor outcomes following breast cancer surgery by integrating it with the electronic medical record. A treatment plan based on this assessment might now entail a social work consult, use of patient navigators, and referrals to community-based services and financial assistance for immediate resource allocation. Furthermore, increasing the interdisciplinary care team's awareness of and engagement with the SDoH will measurably enhance the patient-provider relationship.[46]

Our study should be viewed in light of limitations including the single-institution, cross-sectional design. Our institution is a specialized, quaternary referral center, and results may not be generalizable to all practice settings. Our study included only a population of insured women undergoing breast cancer surgery, yet ADI was still associated with patient-reported outcomes. This only strengthens our findings; effect sizes are expected to be magnified in the general population with worse socioeconomic characteristics, particularly among those without baseline insurance coverage. The outcomes were measured at a single point in time and do not demonstrate a causal relationship. Finally, all patient-reported outcomes were self-reported. We minimized reporting bias by using objective data from patient medical records, employing validated patient-reported outcome measures, and administering the survey within 18 months of surgery. In addition, by including only consecutive patients, we were able to minimize selection bias. Future prospective multicenter studies that address these limitations are needed. Notwithstanding, our study is the first to assess the impact of ADI on patient-reported outcomes after breast cancer surgery using validated measures and robust statistical analysis.

Conclusion

Patients residing in vulnerable neighborhoods characterized by high ADI who underwent breast cancer surgery were more likely to have worse psychological well-being and quality of life. Patients of color (i.e.

African American and Hispanic) and those with high BMI were also likely to come from an economic background characterized by high deprivation. These data suggest that ADI is an important driver of quality of life and psychosocial well-being after breast cancer surgery, and advocate for the incorporation of this metric in a “patient-centric” approach to facilitate personalized care, especially for vulnerable populations.

Declarations

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Competing Interests:

Dr. Offodile reports research funding from Blue Cross Blue Shield Affordability Cures Research Consortium, University Cancer Foundation, Rising Tide Foundation for Clinical Cancer Research, and the National Academy of Medicine. Dr. Offodile also is an unpaid board member of the Patient Advocate Foundation and reports honorarium from the Indiana University and University of Tennessee. All are unrelated to the submitted work. The other authors have no financial or non-financial disclosures.

Author Contribution:

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by [Abbas M Hassan], [Huan T. Nguyen] and [Jun Liu]. The first draft of the manuscript was written by [Abbas M. Hassan], [Aneaze C. Offodile] and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Data Availability:

The datasets generated during and/or analyzed during the current study are not publicly available due to institutional policies but are available from the corresponding author on reasonable request.

Ethics approval:

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent to participate:

This is an observational study and The University of Texas MD Anderson Cancer has waived informed consent.

References

1. Hawkins RB, Charles EJ, Mehaffey JH, Williams CA, Robinson WP, Upchurch GR, et al. Socioeconomic Distressed Communities Index associated with worse limb-related outcomes after infrainguinal bypass. *J Vasc Surg.* 2019;70(3):786-94.e2.
2. Braveman P, Gottlieb L. The social determinants of health: it's time to consider the causes of the causes. *Public Health Rep.* 2014;129 Suppl 2(Suppl 2):19-31.
3. Zogg CK, Scott JW, Jiang W, Wolf LL, Haider AH. Differential access to care: The role of age, insurance, and income on race/ethnicity-related disparities in adult perforated appendix admission rates. *Surgery.* 2016;160(5):1145-54.
4. De Oliveira GS, Jr., McCarthy RJ, Wolf MS, Holl J. The impact of health literacy in the care of surgical patients: a qualitative systematic review. *BMC Surg.* 2015;15:86.
5. Hälleberg Nyman M, Nilsson U, Dahlberg K, Jaensson M. Association Between Functional Health Literacy and Postoperative Recovery, Health Care Contacts, and Health-Related Quality of Life Among Patients Undergoing Day Surgery: Secondary Analysis of a Randomized Clinical Trial. *JAMA Surg.* 2018;153(8):738-45.
6. Wright JP, Moses K, Idrees K. Making the Case for Importance of Health Literacy in the Surgical Population. *JAMA Surg.* 2018;153(8):745-6.
7. Diaz A, Hyer JM, Barmash E, Azap R, Paredes AZ, Pawlik TM. County-level Social Vulnerability is Associated With Worse Surgical Outcomes Especially Among Minority Patients. *Ann Surg.* 2021;274(6):881-91.
8. Dos Santos Marques IC, Theiss LM, Wood LN, Gunnells DJ, Hollis RH, Hardiman KM, et al. Racial disparities exist in surgical outcomes for patients with inflammatory bowel disease. *Am J Surg.* 2021;221(4):668-74.
9. Arroyo NS, White RS, Gaber-Baylis LK, La M, Fisher AD, Samaru M. Racial/Ethnic and Socioeconomic Disparities in Total Knee Arthroplasty 30- and 90-Day Readmissions: A Multi-Payer and Multistate Analysis, 2007-2014. *Popul Health Manag.* 2019;22(2):175-85.
10. Daniel H, Bornstein SS, Kane GC. Addressing social determinants to improve patient care and promote health equity: an American College of Physicians position paper. *Annals of internal medicine.* 2018;168(8):577-8.
11. Kind AJH, Buckingham WR. Making Neighborhood-Disadvantage Metrics Accessible - The Neighborhood Atlas. *N Engl J Med.* 2018;378(26):2456-8.

12. 12. Kolak M, Bhatt J, Park YH, Padrón NA, Molefe A. Quantification of Neighborhood-Level Social Determinants of Health in the Continental United States. *JAMA Netw Open*. 2020;3(1):e1919928.
13. 13. Arcaya MC, Tucker-Seeley RD, Kim R, Schnake-Mahl A, So M, Subramanian SV. Research on neighborhood effects on health in the United States: A systematic review of study characteristics. *Soc Sci Med*. 2016;168:16-29.
14. 14. Gomez SL, Shariff-Marco S, DeRouen M, Keegan TH, Yen IH, Mujahid M, et al. The impact of neighborhood social and built environment factors across the cancer continuum: Current research, methodological considerations, and future directions. *Cancer*. 2015;121(14):2314-30.
15. 15. Kurani SS, McCoy RG, Lampman MA, Doubeni CA, Finney Rutten LJ, Inselman JW, et al. Association of Neighborhood Measures of Social Determinants of Health With Breast, Cervical, and Colorectal Cancer Screening Rates in the US Midwest. *JAMA Netw Open*. 2020;3(3):e200618.
16. 16. Catalyst N. Social determinants of health (SDOH). *NEJM Cataly*. 2017;3(6).
17. 17. Reitzel LR, Nguyen N, Zafereo ME, Li G, Wei Q, Sturgis EM. Neighborhood deprivation and clinical outcomes among head and neck cancer patients. *Health Place*. 2012;18(4):861-8.
18. 18. Ghirimoldi FM, Schmidt S, Simon RC, Wang CP, Wang Z, Brimhall BB, et al. Association of Socioeconomic Area Deprivation Index with Hospital Readmissions After Colon and Rectal Surgery. *J Gastrointest Surg*. 2021;25(3):795-808.
19. 19. Rosenzweig MQ, Althouse AD, Sabik L, Arnold R, Chu E, Smith TJ, et al. The Association Between Area Deprivation Index and Patient-Reported Outcomes in Patients with Advanced Cancer. *Health Equity*. 2021;5(1):8-16.
20. 20. Singh GK, Lin CC. Area Deprivation and Inequalities in Health and Health Care Outcomes. *Ann Intern Med*. 2019;171(2):131-2.
21. 21. Hyer JM, Tsilimigras DI, Diaz A, Mirdad RS, Azap RA, Cloyd J, et al. High Social Vulnerability and "Textbook Outcomes" after Cancer Operation. *J Am Coll Surg*. 2021;232(4):351-9.
22. 22. Offodile AC, 2nd, Asaad M, Boukvalas S, Bailey C, Lin YL, Teshome M, et al. Financial Toxicity Following Surgical Treatment for Breast Cancer: A Cross-sectional Pilot Study. *Ann Surg Oncol*. 2021;28(5):2451-62.
23. 23. Coroneos CJ, Lin YL, Sidey-Gibbons C, Asaad M, Chin B, Boukvalas S, et al. Correlation Between Financial Toxicity, Quality of Life, and Patient Satisfaction in an Insured Population of Breast Cancer Surgical Patients: A Single-Institution Retrospective Study. *J Am Coll Surg*. 2021;232(3):253-63.
24. 24. Pusic AL, Klassen AF, Scott AM, Klok JA, Cordeiro PG, Cano SJ. Development of a new patient-reported outcome measure for breast surgery: the BREAST-Q. *Plast Reconstr Surg*. 2009;124(2):345-53.
25. 25. Ware J, Jr., Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care*. 1996;34(3):220-33.
26. 26. Lawrence WF, Fleishman JA. Predicting EuroQoL EQ-5D preference scores from the SF-12 Health Survey in a nationally representative sample. *Med Decis Making*. 2004;24(2):160-9.

27. 27. Farivar SS, Cunningham WE, Hays RD. Correlated physical and mental health summary scores for the SF-36 and SF-12 Health Survey, V.I. *Health Qual Life Outcomes*. 2007;5:54.
28. 28. Bailey CM, Asaad M, Boukovalas S, Lin YL, Kothamasu V, Kapur SK, et al. Understanding the Relationship between Breast Reconstruction Subtype and Risk of Financial Toxicity: A Single-Institution Pilot Study. *Plast Reconstr Surg*. 2021;148(1):1e-11e.
29. 29. Zuelsdorff M, Larson JL, Hunt JFV, Kim AJ, Kosciak RL, Buckingham WR, et al. The Area Deprivation Index: A novel tool for harmonizable risk assessment in Alzheimer's disease research. *Alzheimers Dement (N Y)*. 2020;6(1):e12039.
30. 30. Messer LC, Laraia BA, Kaufman JS, Eyster J, Holzman C, Culhane J, et al. The development of a standardized neighborhood deprivation index. *J Urban Health*. 2006;83(6):1041-62.
31. 31. Mehaffey JH, Hawkins RB, Charles EJ, Turrentine FE, Kaplan B, Fogel S, et al. Community level socioeconomic status association with surgical outcomes and resource utilisation in a regional cohort: a prospective registry analysis. *BMJ Qual Saf*. 2020;29(3):232-7.
32. 32. Mehaffey JH, Hawkins RB, Charles EJ, Turrentine FE, Hallowell PT, Friel C, et al. Socioeconomic "Distressed Communities Index" Improves Surgical Risk-adjustment. *Ann Surg*. 2020;271(3):470-4.
33. 33. Lynch EE, Malcoe LH, Laurent SE, Richardson J, Mitchell BC, Meier HCS. The legacy of structural racism: Associations between historic redlining, current mortgage lending, and health. *SSM Popul Health*. 2021;14:100793.
34. 34. Bailey ZD, Krieger N, Agénor M, Graves J, Linos N, Bassett MT. Structural racism and health inequities in the USA: evidence and interventions. *Lancet*. 2017;389(10077):1453-63.
35. 35. Roeder A. Zip code better predictor of health than genetic code 2014 [Available from: <https://www.hsph.harvard.edu/news/features/zip-code-better-predictor-of-health-than-genetic-code/>].
36. 36. Ritchie D. Our zip code may be more important than our genetic code: Social determinants of health, law and policy. *Rhode Island Medical Journal*. 2013;96:14-.
37. 37. Saini G, Ogden A, McCullough LE, Torres M, Rida P, Aneja R. Disadvantaged neighborhoods and racial disparity in breast cancer outcomes: the biological link. *Cancer Causes Control*. 2019;30(7):677-86.
38. 38. McGinnis JM, Williams-Russo P, Knickman JR. The case for more active policy attention to health promotion. *Health Aff (Millwood)*. 2002;21(2):78-93.
39. 39. Garg A, Boynton-Jarrett R, Dworkin PH. Avoiding the Unintended Consequences of Screening for Social Determinants of Health. *Jama*. 2016;316(8):813-4.
40. 40. Brooks-LaSure C, Fowler E, Seshamani M, Tsai D. Innovation at the Centers for Medicare and Medicaid Services: a vision for the next 10 years 2021 [Available from: <https://www.healthaffairs.org/doi/10.1377/hblog20210812.211558/full/>].
41. 41. Zafar SY, Abernethy AP. Financial toxicity, Part I: a new name for a growing problem. *Oncology (Williston Park)*. 2013;27(2):80-1, 149.

42. Meyer OL, Castro-Schilo L, Aguilar-Gaxiola S. Determinants of mental health and self-rated health: a model of socioeconomic status, neighborhood safety, and physical activity. *Am J Public Health*. 2014;104(9):1734-41.
43. Knighton AJ, Brunisholz KD, Savitz ST. Detecting Risk of Low Health Literacy in Disadvantaged Populations Using Area-based Measures. *EGEMS (Wash DC)*. 2017;5(3):7.
44. Girard N. Evidence appraisal of Waljee J, McGlinn EP, Sears ED, Chung KC. Patient expectations and patient-reported outcomes in surgery: a systematic review: *Surgery*. 2014;155(5):799-808. *Aorn j*. 2016;103(2):250-5.
45. Mancuso CA, Rincon M, McCulloch CE, Charlson ME. Self-efficacy, depressive symptoms, and patients' expectations predict outcomes in asthma. *Med Care*. 2001;39(12):1326-38.
46. Bourgois P, Holmes SM, Sue K, Quesada J. Structural Vulnerability: Operationalizing the Concept to Address Health Disparities in Clinical Care. *Acad Med*. 2017;92(3):299-307.

Tables

Table I

Patient characteristics stratified by 3-category area deprivation index

Variables	All	Prosperous/comfortable (ADI: 0–39)	Mid-tier (ADI: 40–59)	At risk/distressed (ADI: 60–100)	P-value
Number of patients	564	278	131	155	
Age, year, (mean ± SD)	60.01 ± 12.42	60.75 ± 11.93	59.4 ± 13.83	59.18 ± 12.03	0.375
BMI, kg/m ² , (mean ± SD)	28.85 ± 6.62	27.73 ± 5.72	29.26 ± 8.11	30.52 ± 6.4	<0.001
Race/Ethnicity, n (%)					0.003
White	420 (74.5)	224 (53.3)	100 (23.8)	96 (22.9)	
Black	56 (9.9)	19 (33.9)	14 (25)	23 (41.1)	
Hispanic	48 (8.5)	17 (35.4)	8 (16.7)	23 (47.9)	
Asian	4 (0.7)	3 (75)	1 (25)	0 (0)	
Native American	1 (0.2)	0 (0)	0 (0)	1 (100)	
Other	35 (6.2)	15 (42.9)	8 (22.9)	12 (34.3)	
Charlson comorbidity index (mean ± SD)	3.51 ± 2	3.41 ± 1.82	3.45 ± 2.09	3.74 ± 2.2	0.539
Type of mastectomy, n (%)					0.971
Lumpectomy/Segmental	314 (55.7)	157 (50)	69 (22)	88 (28)	
Unilateral total	50 (8.9)	23 (46)	15 (30)	12 (24)	
Bilateral total	15 (2.7)	8 (53.3)	3 (20)	4 (26.7)	
Modified radical	11 (2)	7 (63.6)	2 (18.2)	2 (18.2)	
Unilateral Skin Sparing	78 (13.8)	36 (46.2)	19 (24.4)	23 (29.5)	
Bilateral Skin Sparing	57 (10.1)	26 (45.6)	13 (22.8)	18 (31.6)	

Unknown	39 (6.9)	21 (53.8)	10 (25.6)	8 (20.5)	
Reconstruction, n (%)					0.524
No	203 (36)	104 (51.2)	49 (24.1)	50 (24.6)	
Yes	361 (64)	174 (48.2)	82 (22.7)	105 (29.1)	
Preoperative radiotherapy, n (%)					0.935
No	547 (97)	271 (49.5)	126 (23)	150 (27.4)	
Yes	14 (2.5)	7 (50)	4 (28.6)	3 (21.4)	
Unknown	3 (0.5)	0 (0)	1 (33.3)	2 (66.7)	

ADI, area deprivation index; BMI, body mass index; SD, standard deviation

Table II

Univariate analysis of patient reported outcomes by 3-category area deprivation index

	All	Prosperous/comfortable (ADI: 0–39)	Mid-tier (ADI: 40–59)	At risk/distressed (ADI: 60–100)	P-value
Mean SF-12 physical, (SD)	46.38 ± 6.16	47.56 ± 5.54	45.51 ± 6.39	44.87 ± 6.67	<0.001
Mean SF-12 mental, (SD)	45.56 ± 6	45.32 ± 5.9	46.28 ± 5.35	45.37 ± 6.72	0.328
Mean BREAST-Q satisfaction with breasts (SD)	68.31 ± 20.68	70.16 ± 19.8	64.02 ± 18.2	68.72 ± 23.91	0.137
Mean BREAST-Q psychosocial wellbeing (SD)	71.7 ± 20.43	74.48 ± 20.35	72.2 ± 21	65.49 ± 18.8	<0.001
Mean BREAST-Q satisfaction with surgeon (SD)	92.38 ± 14.92	92.4 ± 16.11	91.1 ± 14.57	93.56 ± 12.55	0.448

ADI, area deprivation index; SF-12, 12-Item Short Form Health Survey; SD, standard deviation.

Table III

Multivariable analysis of patient reported outcomes by 3-category area deprivation index

	Prosperous/comfortable (ADI: 0–39)	Mid-tier (ADI: 40–59)	At risk/distressed (ADI: 60–100)	P-value
	Score (95% CI)	Score (95% CI)	Score (95% CI)	
SF-12 physical ^a	46.3 (45.3-47.3)	44.9 (43.7-46.1)	44.9 (43.8-46.0)	0.032
SF-12 mental ^b	45.5 (44.5-46.6)	46.9 (45.6-48.2)	46.1 (44.8-47.5)	0.123
BREAST-Q satisfaction with breasts ^c	69.2 (65.3-73.1)	64.9 (59.3-70.5)	69.7 (64.3-75.0)	0.386
BREAST-Q psychosocial wellbeing ^d	69.7 (66.4-73.1)	69.3 (65.1-73.6)	63.5 (59.32-67.8)	0.011
BREAST-Q satisfaction with surgeon ^e	92.0 (90.2-93.9)	91.2 (88.5-93.9)	94.1 (91.5-96.8)	0.289

ADI, area deprivation index; SF-12, 12-Item Short Form Health Survey; CI, confidence interval. a: The model was adjusted for age, body mass index (BMI), Charlson Comorbidity Index (CCI), overall complications and race

b: The model was adjusted for type of mastectomy, age, BMI

c: The model was adjusted for age, BMI, CCI and overall complications

d: The model was adjusted for age, BMI, CCI, overall complications and type of mastectomy

e: The model was adjusted for BMI, CCI and overall complication