Surgery in Practice and Science 13 (2023) 100167

Contents lists available at ScienceDirect

Surgery in Practice and Science

journal homepage: www.sciencedirect.com/journal/surgery-in-practice-and-science

# Social vulnerability is associated with more stomas after surgery for uncomplicated diverticulitis

Jorge G. Zarate Rodriguez *, William C. Chapman Jr., Dominic E. Sanford, Chet W. Hammill, Paul E. Wise, Radhika K. Smith, Sean C. Glasgow, Matthew L. Silviera

*Department of Surgery, Washington University School of Medicine in St Louis, St Louis, MO, USA*

ARTICLE INFO

*Keywords:*
Social vulnerability
Stoma
Diverticulitis
Healthcare disparities

ABSTRACT

*Background:* Previous research has demonstrated disparities in surgical management of diverticulitis based on various patient characteristics, including race. Recent investigation suggests environmental factors may also play a prominent role in patient outcomes. The Center for Disease Control and Prevention's Social Vulnerability Index (SVI) is emerging as a useful tool for studying this effect and may better characterize social determinants of health among colorectal pathology.

*Methods:* This was a retrospective review of patients in the Healthcare Cost and Utilization Project Florida State Inpatient Database (2006–2014), matched by ZIP code to their corresponding SVI. Patients admitted through the emergency department with a primary diagnosis of diverticulitis were included. The rate of stoma creation amongst patients undergoing non-elective surgery for uncomplicated diverticulitis was compared by SVI.

*Results:* Of the 4,212 patients in this study who underwent colectomy, 2,310 (54.8%) received a stoma. Compared to those with low vulnerability, highly vulnerable patients were more likely to receive a stoma ($p = 0.014$). In multivariable logistic analysis, increasing vulnerability was independently associated with increased odds of stoma creation (OR 1.08, $p<0.001$). Female sex (OR 0.86, $p = 0.027$), nonwhite race (OR 0.63, $p<0.001$), and minimally invasive surgical approach (OR 0.41, $p<0.001$) were associated with decreased odds of stoma creation.

*Conclusions:* High social vulnerability was associated with stoma creation amongst patients who underwent non-elective surgery for uncomplicated diverticulitis. Contrarily, nonwhite race was associated with decreased rate of stoma creation, highlighting the importance of using more comprehensive metrics of patient vulnerability such as SVI, rather than race, in disparities research.

## Introduction

In recent years, the medical community has begun to recognize the pervasive effects of factors such as race, gender, and socioeconomic status on patient care patterns and health outcomes. [1–3] Acute diverticulitis is a common condition that is only increasing in prevelance; despite existing treatment guidelines, disparities have been described in the management of this condition. [4] Patient race, insurance status, and even primary language, may affect timing and severity of presentation, rates of non-elective resection, the rates of use of minimally invasive surgical techniques, and postoperative outcomes including length of stay, complication rate, and perioperative mortality. [5–8].

In addition to patient-level characteristics, there is an increasing understanding that neighborhood-level factors may also influence a patient's health outcomes. Housing quality, access to transportation, and educational and employment opportunities can affect patients' health and their access to primary care, negatively impacting their overall outcomes. The Center for Disease Control and Prevention's social vulnerability index (SVI) is a composite measure of a neighborhood's resiliency, which is calculated by ranking census tracts according to various social factors such as poverty, education level, number of

Disclaimers: The authors report no disclosures.Funding: No additional sources of funding to report.Previous presentations: Podium presentation, 2022 American Society of Colon and Rectal Surgeons Annual Scientific Meeting, Tampa, FL (April 30-May 4, 2022)Author contributions: All authors (Drs Zarate Rodriguez, Chapman, Sanford, Hammill, Wise, Smith, Glasgow, Silviera) meet ICMJE criteria for authorship.

* Corresponding author.
*E-mail address:* j.zarate@wustl.edu (J.G. Zarate Rodriguez).

https://doi.org/10.1016/j.sipas.2023.100167
Received 11 April 2023; Accepted 12 April 2023
Available online 28 April 2023

children and elderly members per household, minority race, crowded housing, and access to vehicles. [9,10] Although originally derived to identify communities most at risk in the event of public health or natural disasters, SVI can also be used to study the effect of a patient's living environment on healthcare outcomes. High SVI, or greater social vulnerability, has been previously associated with more severe surgical disease at the time of presentation, higher need for non-elective surgery, higher rates of postoperative complications and readmission, lower rates of attainment of optimal oncologic outcomes, and greater hospital-associated expenditures. [11–14].

Yet, the discrete impact or effect-size of these varied patient and neighborhood-level factors remains unclear. We hypothesized that the patient environment – quantified by the SVI of their neighborhood – would correlate with variations in patient outcomes in the treatment of uncomplicated acute diverticulitis. The primary outcome in this study was the rate of stoma creation during non-elective surgery for uncomplicated diverticulitis. Since standard of care for this condition typically includes conservative management or surgical resection with primary anastomosis, stoma creation was considered a surrogate marker of deviation from standard practice. [15,16]

## Materials & methods

A retrospective cohort study was performed using administrative billing data from the Florida State Inpatient Database (SID) for years 2006 through 2014, as made available by the Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project (HCUP). [17] This SID included records from 22 million discharges across all non-federal inpatient facilities in the state of Florida during the study period; variables included clinical and administrative data such as ICD-9-CM diagnosis and procedure codes, patient demographics, payer, total charges, and encrypted dates of admission, discharge, and procedure performance. The Florida SID is known for its comprehensive reporting of insurance claims data that can reliably be tracked with high veracity across hospitals, over time, and despite changes in location of care or payor status. The research protocol was deemed non-human research by the Washington University Institutional Review Board (IRB# 201,811,131).

### *Patient selection*

Patients undergoing inpatient admission through an emergency department with a primary diagnosis of diverticulitis were initially selected. Severity of disease was further classified based on the concomitant coding of secondary diagnoses such as intraabdominal, pelvic, or retroperitoneal abscesses, free perforation, gross peritonitis, or fistula. Only patients without these secondary diagnoses (classified as having uncomplicated disease) were included in this study. Procedure codes were then used to determine which patients underwent colectomy during their admission, and this population was further stratified based on the creation of primary anastomosis (Supplemental Table 1). In this analysis, only patients undergoing colectomy during an admission originating in the emergency department were included. Patients residing outside the state of Florida, with a history of inflammatory bowel disease, or not between the ages of 18 and 90 were specifically excluded.

### *Independent variables*

Patient socio-demographic data were collected from the SID including age, sex, race (white vs nonwhite), ZIP code, median income quartile, insurance status (for the purpose of this study categorized as follows: government insurance = Medicare and Medicaid; private insurance = private insurance and self-pay; and other insurance = no charge or other), and urban-rural classification (where big metropolitan = central and fringe metropolitan areas with population ≥1 million; small metropolitan = medium and small metropolitan areas with population between 50,000–1 million; and not metropolitan = micropolitan areas and non-metropolitan/micropolitan areas with population <50,000). Individual medical comorbidities were determined via analysis of index admissions and all inpatient admissions in the preceding 365 days with Quan's enhanced Elixhauser algorithm. [18–20] The Elixhauser Mortality Index, a continuous weighted sum of all comorbidities produced by the Elixhauser algorithm, was calcuated for use in this study's multivariate models. [21] Hospital volume was calculated by summing all admissions for diverticulitis across the study period by institution and then categorized into quartiles of volume.

Social vulnerability index (SVI) is publicly available through the Center for Disease Control (CDC). The SVI is a composite measure that uses census data to rank neighborhoods across a variety of social factors to estimate social vulnerability. These factors span four main domains, or subthemes: (1) socioeconomic status, (2) household composition and vulnerability, (3) minority status and language, and (4) housing type and transportation. [9,10] SVI and SVI subtheme data are reported in a scale from 0 to 1 to represent percentiles, where 0.5 represents the mean (50th percentile) and higher scores reflect a greater degree of vulnerability. Patients in SID were merged to their corresponding county SVI by ZIP code. To faciliate comparisons, patients were divided into quartiles, where the least vulnerable patients (first quartile) had SVI <0.25, and the most vulnerable patients fourth quartile) had SVI >0.75.

### *Outcomes*

The primary outcome in this study was the rate of stoma creation during non-elective surgery for uncomplicated diverticulitis. Since uncomplicated diverticulitis by definition occurs in the absence of intra-abdominal contamination, standard of care typically includes conservative management or surgical resection with primary anastomosis. In this setting, creation of a stoma could be an unusual deviation from practice standards and potentially related to factors beyond the colonic pathology. [15,16] Therefore, stoma creation among this select population was considered a surrogate marker of standard practice deviation.

### *Statistical analyses*

The characteristics and outcomes of patients with uncomplicated diverticulitis were compared by SVI. Comparisons were made using chi-square tests for categorical variables and unpaired Students' *t*-test for continuous variables. Multivariable logistic regression was performed to account for the impact of covariables on the primary outcome that may confound the univariate analysis. Social vulnerability (SVI), age, gender, race, income, insurance status, hospital volume, minimally invasive surgical approach, urban-rural classification, and comorbidity burden (Elixhauser mortality score) were included in the models. In these models, SVI was included as a continuous variable and converted to a 0–10 scale. Additional regression models were performed using each of the SVI subthemes to evaluate their proportional contributions to patient outcomes. All statistical analyses were performed using SAS 9.4 (SAS Institute). All p-values were two-sided and a value less than 0.05 was considered statistically significant.

## Results

In total, there were 94,949 patients admitted for uncomplicated diverticulitis during the study period, of which 4212 (4.4%) underwent surgery. Of those 4212 surgical patients, 1098 (26.1%) were in the least socially vulnerable group with SVI scores in the 1st quartile compared to 624 (14.8%) in the 4th quartile. Compared to the least vulnerable patients, the most vulnerable patients were more likely to be nonwhite race (57.4% vs 9.4%, $p<0.001$), have lower income ($p<0.001$), have government insurance ($p = 0.004$), live in big metropolitan areas

($p<0.001$), and seek care in high colorectal surgery volume centers ($p<0.001$) (Table 1). In terms of comorbidities, the most vulnerable patients were more likely to have been diagnosed with diabetes mellitus (22.1% vs 14.9%, $p<0.001$), hypertension (62.5% vs 56.2%, $p = 0.011$), and less likely to suffer from alcohol abuse (1.9% vs 4.9%, $p = 0.002$) and depression (5.6% vs 9.8%, $p = 0.002$) compared to patients with the lowest social vulnerability (Supplemental Table 2). However, there was no significant difference in the composite Elixhauser mortality index scores between the most and least vulnerable patients (5.8 SD 9.8 vs 5.9 SD 9.5, $p = 0.876$).

Of the 4212 patients in this study, 2310 (54.8%) received stomas and 1902 (45.2%) did not (Table 2). Compared to patients who underwent primary anastomosis, patients who underwent stoma creation were older (64.1 SD 14.8 vs 61.1 SD 15.7 years, $p<0.001$), less likely to be nonwhite race (18.7% vs 25.1%, $p<0.001$), less likely to have undergone minimally invasive surgery (12.3% vs 25.5, $p<0.001$), more likely to have government insurance (55.6% vs 50.1%, $p<0.001$), and had a higher comorbidity burden (7.3 SD 10.4 vs 4.7 SD 8.3, $p<0.001$). The rate of stoma creation was directly associated with higher social vulnerability compared to lower (54.2% vs 48.0%, $p = 0.014$) regardless of ostomy type (ileostomy 4.5% vs 2.5% $p = 0.021$; colostomy 49.7% vs 45.4%, $p = 0.084$).

On multivariable analysis, increasing SVI was independently associated with stoma creation (OR 1.08, CI 1.05–1.11, $p<0.001$) (Fig. 1). Additionally, increasing age (OR 1.01, CI 1.00–1.02, $p<0.001$) and increasing comorbidity burden (OR 1.03, CI 1.02–1.03, $p<0.001$) were also associated with increased odds of stoma creation. Conversely, female gender (OR 0.86, CI 0.76–0.98, $p = 0.027$), nonwhite race (OR 0.63, CI 0.53–0.74, $p<0.001$), and minimally invasive approach (OR 0.41, CI 0.35–0.49, $p<0.001$) were associated with decreased odds of stoma creation. The risk-adjusted probability of stoma creation among patients with high social vulnerability was an absolute increased probability of 10.3% (95% CI 8.5% to 13.4%) compared to patients with low social vulnerability (Table 3). The risk-adjusted probabilities by patient race were also calculated; compared to white race, non-white race was an absolute decreased probability of stoma formation of 9.6% (95% CI −10% to −8.6%).

Regression analysis of each SVI subtheme also demonstrated significant positive associations with stoma creation (Table 4). High vulnerability along the socioeconomic status subtheme conferred an absolute increase in the risk-adjusted probability of stoma formation of 8.9% (95% CI 6.1 to 11.7%), and high vulnerability along the household composition and disability subtheme an absolute increase of 5.6% (95% CI 3.6 to 7.7%). High vulnerability along the minority status and language subtheme resulted in the lowest increase in the risk-adjusted probability of stoma at 4.9% (95% CI 2.8 to 7.0%), while high vulnerability along the household type and transportation resulted in the highest increase in the risk of stoma formation at 9.1% (95% CI 6.8 to 11.3%).

**Table 1**
Characteristics of patients who underwent urgent/emergent colectomy for uncomplicated diverticulitis living in counties with the lowest (1st quartile) and highest (4th quartile) social vulnerability indeces (SVI).

| Variable | Lowest SVI ($N$ = 1098) | Highest SVI ($N$ = 624) | p-value |
|---|---|---|---|
| Age, years (SD) | 62.6 (14.7) | 63.7 (15.7) | 0.146 |
| Female sex, n (%) | 575 (52.4) | 351 (56.3) | 0.120 |
| Nonwhite race, n (%) | 103 (9.4) | 355 (57.4) | <0.001 |
| Median income, n (%) | | | <0.001 |
| 1st quartile | 125 (11.6) | 247 (40.4) | |
| 2nd quartile | 334 (30.9) | 146 (23.9) | |
| 3rd quartile | 377 (34.9) | 127 (20.8) | |
| 4th quartile | 245 (22.7) | 91 (14.9) | |
| Primary payer, n (%) | | | 0.016 |
| Government insurance | 583 (53.1) | 365 (58.5) | |
| Private insurance | 462 (42.1) | 195 (31.2) | |
| Other insurance | 53 (4.8) | 39 (6.2) | |
| Urban-rural classification, n (%) | | | <0.001 |
| Big metropolitan | 415 (42.2) | 371 (68.1) | |
| Small metropolitan | 495 (50.4) | 120 (22.0) | |
| Not metropolitan | 74 (7.6) | 54 (9.9) | |
| Hospital volume, n (%) | | | <0.001 |
| 1st quartile | 56 (5.1) | 28 (4.5) | |
| 2nd quartile | 320 (29.1) | 67 (10.7) | |
| 3rd quartile | 377 (34.3) | 125 (20.0) | |
| 4th quartile | 345 (31.4) | 404 (64.7) | |
| MIS approach, n (%) | 229 (20.9) | 131 (21.0) | 0.946 |
| Elixhauser mortality index (SD) | 5.9 (9.5) | 5.8 (9.8) | 0.876 |
| Stoma rate | 527 (48.0) | 338 (54.2) | 0.014 |
| Ileostomy | 27 (2.5) | 28 (4.5) | 0.021 |
| Colostomy | 498 (45.4) | 310 (49.7) | 0.084 |
| Both | 2 (0.2%) | 0 | 0.286 |

SVI: social vulnerability index; MIS: minimally invasive surgery; SD: standard deviation.

**Table 2**
Characteristics of patients who underwent urgent/emergent colectomy for uncomplicated diverticulitis with and without stoma.

| Variable | No stoma ($N$ = 1902) | Stoma ($N$ = 2310) | p-value |
|---|---|---|---|
| Age, years (SD) | 61.1 (15.7) | 64.1 (14.8) | <0.001 |
| Female sex, n (%) | 1022 (53.7) | 1202 (48) | 0.272 |
| Nonwhite race, n (%) | 476 (25.1) | 430 (18.7) | <0.001 |
| Median income, n (%) | | | 0.354 |
| 1st quartile | 388 (20.8) | 512 (22.4) | |
| 2nd quartile | 519 (27.9) | 656 (28.7) | |
| 3rd quartile | 521 (28.0) | 590 (25.8) | |
| 4th quartile | 435 (23.4) | 526 (23.0) | |
| Primary payer, n (%) | | | 0.001 |
| Government insurance | 953 (50.1) | 1284 (55.6) | |
| Private insurance | 836 (44.0) | 891 (38.6) | |
| Other insurance | 113 (5.9) | 135 (5.8) | |
| Urban-rural classification, n (%) | | | 0.124 |
| Big metropolitan | 964 (57.6) | 1211 (59.5) | |
| Small metropolitan | 615 (36.7) | 690 (33.9) | |
| Not metropolitan | 95 (5.7) | 136 (6.7) | |
| Hospital volume, n (%) | | | 0.174 |
| 1st quartile | 91 (4.8) | 102 (4.4) | |
| 2nd quartile | 368 (19.4) | 408 (17.7) | |
| 3rd quartile | 603 (31.7) | 703 (30.4) | |
| 4th quartile | 840 (44.2) | 1097 (47.5) | |
| MIS approach, n (%) | 485 (25.5) | 285 (12.3) | <0.001 |
| Elixhauser mortality index (SD) | 4.7 (8.3) | 7.3 (10.4) | <0.001 |
| SVI, n (%) | | | <0.001 |
| 1st quartile | 571 (30.0) | 527 (22.8) | |
| 2nd quartile | 616 (32.4) | 817 (35.4) | |
| 3rd quartile | 429 (22.6) | 628 (27.2) | |
| 4th quartile | 286 (15.0) | 338 (14.6) | |

SVI: social vulnerability index; MIS: minimally invasive surgery; SD: standard deviation.

## Discussion

This study investigated the association between various demographic and socioeconomic factors and stoma creation in patients undergoing non-elective colectomy for uncomplicated diverticulitis. Multiple factors were associated with stoma formation among this cohort. As hypothesized, higher social vulnerability was directly associated with increased odds of stoma creation in both univariate and regression analyses. Similarly, greater vulnerability across all four subthemes of the composite SVI metric – socioeconomic status, household composition and vulnerability, minority status and language, and housing type and transportation – was associated with stoma formation.

But these data also highlight the complexity of the relationship between patient race and operative outcomes. Prior research investigating

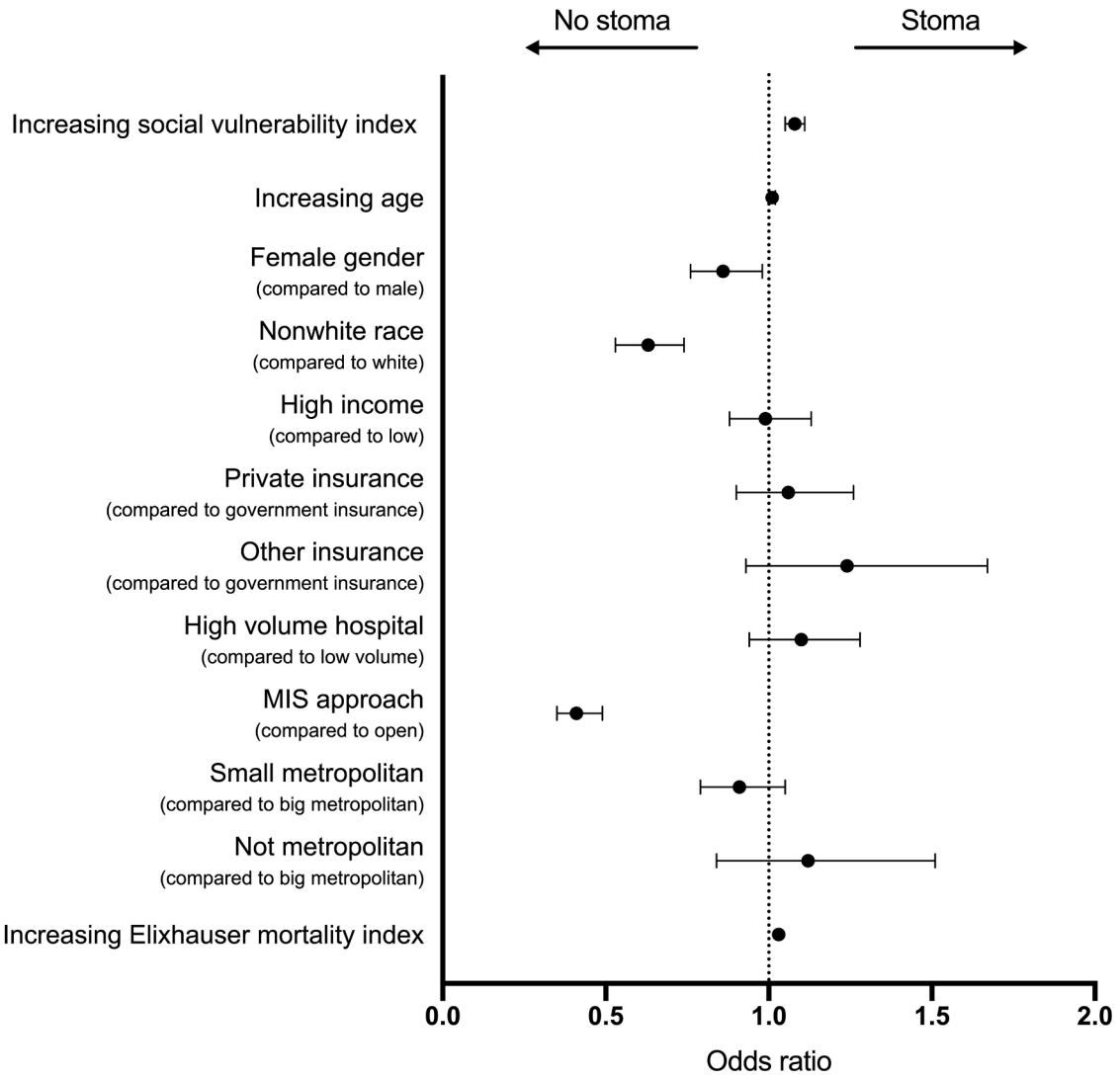


**Fig. 1.** Multivariable logistic regression model for stoma creation among patients undergoing urgent/emergent colectomy for uncomplicated diverticulitis. (MIS: minimally invasive surgery).

**Table 3**
Adjusted probabilities of stoma creation for patients undergoing urgent/emergent colectomy for uncomplicated diverticulitis by social vulnerability (SVI) and patient race.

| Variable | Probability of stoma creation (95% CI) | Absolute difference (95% CI) |
|---|---|---|
| SVI | | |
| Low SVI (20th percentile) | 37.5% (31.9% to 44.0%) | |
| High SVI (80th percentile) | 47.8% (40.4% to 57.4%) | + 10.3% (8.5% to 13.4%) |
| Race | | |
| White | 34.3% (29.4% to 39.6%) | |
| Nonwhite | 24.7% (19.4% to 31.0%) | - 9.6% (−10% to −8.6%) |

Probabilities were calculated from the logistic regression model of stoma formation holding all other covariates at reference values. SVI: social vulnerability index; CI: confidence interval.

disparities within diverticulitis management has frequently found significant associations between patient race and poor outcomes. [22] Black patients with diverticulitis have more emergency surgery, higher in-hospital mortality and hospital-associated costs, and fewer minimally invasive surgeries compared to white patients. [6,7] Disparities in surgical care have also been described for minority patients with primary languages other than English, for whom the odds of emergency resection for acute diverticulitis was 30% higher compared to primarily English-speakers. [5] Previous research studying the relationship of SVI and race specifically has demonstrated a synergistic effect between high social vulnerability and minority race, resulting in worse patient outcomes after surgery for nonwhite patients. [13,23] In this study, though, nonwhite race was associated with decreased odds of stoma formation. We conclude, therefore, that more comprehensive measures of socioeconomic status, such as SVI, may account for the disparity in stoma creation described herein.

These findings could also potentially be explained with selection bias, since only patients who underwent surgery for uncomplicated diverticulitis where included in the study cohort. It is possible white patients were more likely to be offered non-operative management than nonwhite patients, selecting for white patients with more severe disease (those at higher risk to fail non-operative management), explaining the association between nonwhite race and decreased odds of stoma formation. If nothing else, this study's findings highlight the complexity of the interactions between social vulnerability, race, and patient outcomes, and the need for further research in this arena. As our understanding of the effect of systemic racism on patient outcomes continues to evolve, future research should strive to employ more sophisticated

**Table 4**
Adjusted probabilities of stoma creation for patients undergoing urgent/emergent colectomy for uncomplicated diverticulitis by social vulnerability (SVI) subtheme.

| Variable | Probability of stoma creation (95% CI) | Absolute difference (95% CI) |
|---|---|---|
| Socioeconomic status | | |
| Low (20th percentile) | 39.5% (38.6% to 40.3%) | |
| High (80th percentile) | 48.4% (44.7% to 52.0%) | + 8.9% (6.1 to 11.7%) |
| Household composition and vulnerability | | |
| Low (20th percentile) | 38.8% (38.1% to 39.4%) | |
| High (80th percentile) | 44.4% (41.7% to 47.1%) | + 5.6% (3.6 to 7.7%) |
| Minority status and language | | |
| Low (20th percentile) | 37.4% (36.8% to 38.1%) | |
| High (80th percentile) | 42.3% (39.6% to 45.1%) | + 4.9% (2.8 to 7.0%) |
| Housing type and transportation | | |
| Low (20th percentile) | 37.4% (36.7% to 38.2%) | |
| High (80th percentile) | 46.5% (43.5% to 49.5%) | + 9.1% (6.8 to 11.3%) |

Probabilities were calculated from the logistic regression model of stoma formation holding all other covariates at reference values. SVI: social vulnerability index; CI: confidence interval.

methodology beyond simple associations of race and patient outcomes. Further elucidating the complexities of these interactions is the finding that while nonwhite race was protective against stoma at the patient level, increased vulnerability within the minority status and language SVI subtheme (reflecting an increased proportion of minority race people and people whose primary language is not English in a community) is associated with an absolute increase in the odds of stoma.

While most disparities research focuses on patient characteristics, social determinants of health at the community level have been recently identified to be just as – if not more – important than individual characteristics in determining patient outcomes. SVI is a composite measure of social vulnerability that was originally devised by the CDC to identify communities with fewer resources and less resilience to withstand public health disasters. [9,10] It is a publicly available metric that ranks counties acccording to 15 different factors pertaining to the realm of social determinants of health including poverty, education level, crowded housing, and access to transportation. When applied to the medical setting, SVI allows for a better understanding of the effect of a patient's lived environment on their health outcomes. Previous research demonstrated that high SVI is associated with increased complication rates, 30-day mortality, and hospital costs after thoracic and abdominal surgery. High SVI has also been linked to poorer outcomes after oncologic surgery. [13,24] Specifically for colorectal disease, a study of Medicare patients with primary diagnoses of diverticulitis or cancer demonstrated that increased social vulnerability was associated with an increased need for non-elective colon resection, as well as higher postoperative complication rates and associated hospital expenditures. [25]

The current study builds upon this work by studying the relationship between SVI and the surgical management of uncomplicated diverticulitis where colon resection and primary anastomosis (in contrast to resection and stoma creation) was used as a proxy for high quality care. Most importantly, Vulnerable patients were more likely to receive suboptimal surgical treatment for uncomplicated diverticulitis. Since SVI is a composite measure, the effects of the contributing vulnerability subthemes were also investigated in this study. While all four SVI subthemes were associated with increased odds of stoma creation, increasing vulnerability in the socioeconomic and housing type and transportation realms were more strongly associated with stoma creation.

In addition to the potential for selection bias, there are other limitations to this study worth mentioning. As is the case with all studies relying on adminstrative data, this study's findings are confounded by unmeasured variables and the lack of some clinically relevant data (such as patient preoperative nutritional status or the specific type of stoma created). HCUP, in particular, is coded by billing experts instead of clinicians, which may add further confounders to the clinical variables included in this study's analysis. Additionally, SVI are assigned at the county-level; heterogeneity in social vulnerability within counties is therefore not accounted for. It is possible that analyses with more granularity would yield different results. Lastly, the relatively high rate of ostomy creation in this population with uncomplicated disease should be considered as a limitation in an of itself that may limit the generalizability of this study's results.

## Conclusion

High social vulnerability correlated with stoma creation amongst patients who underwent non-elective inpatient surgery for uncomplicated acute diverticulitis. Unexpectedly, nonwhite race was associated with decreased rate of stoma creation, highlighting the importance of using more comprehensive metrics of patient vulnerability such as SVI to study disparities in care and target interventions.

## Disclosures

The author reports no disclosures or conflicts of interest.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgments

None.

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.sipas.2023.100167.

## References

[1] Tsai TC, Orav EJ, Joynt KE. Disparities in surgical 30-day readmission rates for Medicare beneficiaries by race and site of care. Ann Surg 2014;259(6):1086–90.
[2] Zarate Rodriguez JG, Cos H, Williams GA, et al. Inability to manage non-severe complications on an outpatient basis increases non-white patient readmission rates after pancreaticoduodenectomy: a large metropolitan tertiary care center experience. Am J Surg 2021;222(5):964–8.
[3] Murphy MM, Simons JP, Ng SC, et al. Racial differences in cancer specialist consultation, treatment, and outcomes for locoregional pancreatic adenocarcinoma. Ann Surg Oncol 2009;16(11):2968–77.
[4] Hall J, Hardiman K, Lee S, et al. The american society of colon and rectal surgeons clinical practice guidelines for the treatment of left-sided colonic diverticulitis. Dis Colon Rectum 2020;63(6):728–47.
[5] Maurer LR, Allar BG, Perez NP, et al. Non-english primary language is associated with emergency surgery for diverticulitis. J Surg Res 2021;268:643–9.
[6] Schneider EB, Haider A, Sheer AJ, et al. Differential association of race with treatment and outcomes in medicare patients undergoing diverticulitis surgery. Arch Surg 2011;146(11):1272–6.
[7] Akram WM, Vohra N, Irish W, Zervos EE, Wong J. Racial disparity in the surgical management of diverticular disease. Am Surg 2021;88(5):31348211058623.
[8] Lassiter RL, Talukder A, Abrams MM, Adam BL, Albo D, White CQ. Racial disparities in the use of laparoscopic surgery to treat colonic diverticulitis Are not fully explained by socioeconomics or disease complexity. Am J Surg 2017;213(4):673–7.
[9] Agency for Toxic Substances and Disease Registry (ASTDR), Center for Disease Control and Prevention (CDC). CDC SVI Documentation 2018. https://www.atsdr.cdc.gov/placeandhealth/svi/documentation/SVI_documentation_2018.html. Published 2018. Accessed 3/1/2022.
[10] Agency for Toxic Substances and Disease Registry (ASTDR), Center for Disease Control and Prevention (CDC). CDC's Social Vulnerability Index. https://svi.cdc.gov/. Published 2018. Accessed 3/1/2022.

[11] Cardenas C, McGillen P, Otalvaro-Acosta L, et al. Social Vulnerability and Appendicitis: single-Institution Study in a High Insurance State. J Surg Res 2022; 275:35–42.
[12] Carmichael H, Moore A, Steward L, Velopulos CG. Using the social vulnerability index to examine local disparities in emergent and elective cholecystectomy. J Surg Res 2019;243:160–4.
[13] 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.
[14] Azap RA, Paredes AZ, Diaz A, Hyer JM, Pawlik TM. The association of neighborhood social vulnerability with surgical textbook outcomes among patients undergoing hepatopancreatic surgery. Surgery 2020;168(5):868–75.
[15] Feingold D, Steele SR, Lee S, et al. Practice parameters for the treatment of sigmoid diverticulitis. Dis Colon Rectum 2014;57(3):284–94.
[16] Rafferty J, Shellito P, Hyman NH, Buie WD. Standards committee of american society of c, rectal s. practice parameters for sigmoid diverticulitis. Dis Colon Rectum 2006;49(7):939–44.
[17] Healthcare Cost and Utilization Project (HCUP). HCUP state inpatient databases (SID). In. Rockville, MD: Agency for Healthcare Research and Quality (AHRQ). 2006–14.
[18] Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use with administrative data. Med Care 1998;36(1):8–27.
[19] Healthcare Cost and Utilization Project (HCUP). Defintions of Comor- bidities, Elixhauser Comorbidity Software, version 3.7. https://www.hcup-us.ahrq.gov/toolssoftware/comorbidity/Table2-FY12-V3_7.pdf. Accessed.
[20] Quan H, Sundararajan V, Halfon P, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. Med Care 2005;43 (11):1130–9.
[21] Moore BJ, White S, Washington R, Coenen N, Elixhauser A. Identifying increased risk of readmission and in-hospital mortality using hospital administrative data: the AHRQ elixhauser comorbidity index. Med Care 2017;55(7):698–705.
[22] Csikesz NG, Singla A, Simons JP, Tseng JF, Shah SA. The impact of socioeconomic status on presentation and treatment of diverticular disease. J Gastrointest Surg 2009;13(11):1993–2001.
[23] Diaz A, Hyer JM, Tsilimigras D, Pawlik TM. The impact of social vulnerability subthemes on postoperative outcomes differs by racial/ethnic minority status. Am J Surg 2022;223(2):353–9.
[24] Hyer JM, Tsilimigras DI, Diaz A, et al. High social vulnerability and "textbook outcomes" after cancer operation. J Am Coll Surg 2021;232(4):351–9.
[25] Diaz A, Barmash E, Azap R, Paredes AZ, Hyer JM, Pawlik TM. Association of county-level social vulnerability with elective versus non-elective colorectal surgery. J Gastrointest Surg 2021;25(3):786–94.