Journal of Gastrointestinal Surgery (2022) 26:2559–2568
https://doi.org/10.1007/s11605-022-05483-x

ORIGINAL ARTICLE

Evaluation of Racial/Ethnic Disparities in the Surgical Management of Inflammatory Bowel Disease

Ana Sofia Ore[1] · Carolina Vigna[1] · Anne Fabrizio[1] · Evangelos Messaris[1]

Received: 26 July 2022 / Accepted: 25 September 2022 / Published online: 17 October 2022

Abstract

Background Disparities in managing inflammatory bowel disease (IBD) are multifactorial and occur at all stages of treatment, including surgical management. We aim to evaluate postoperative morbidity after abdominopelvic surgery among different racial/ethnic groups after surgical management of CD and UC and account for preoperative characteristics that may impact outcomes.

Methods Patients were identified using the National Surgical Quality Improvement Project (NSQIP) file and merged with the targeted proctectomy (2016–2019) and colectomy file (2012–2019). All patients undergoing elective surgical management for ICD9/10 codes for CD and UC were included. The primary outcome was composite postoperative morbidity (CPM), a metric that identifies postoperative morbidity with available variables. Multivariable logistic regression modeling was performed to test the association between race/ethnicity and other risk factors with CPM. Postoperative outcomes were evaluated using propensity score modeling with 1:1 matching without replacement as a secondary analysis.

Results In both CD and UC, CPM was highest for Black patients with 27.5% (326) and 26.1% (81), respectively. Followed by Hispanic patients with a CPM of 21.1% (73) after surgery for CD ($p < 0.001$) and 21.2% (31) for Asian patients after resection for UC ($p = 0.005$). After regression modeling, we found increased odds of CPM for Black patients after surgery for UC (OR 1.48, $p = 0.013$) and CD (OR 1.17, $p < 0.001$). Following propensity score matching (PSM), stoma creation rates were higher in Asian (10.4%, $p = 0.010$) and Hispanic patients (11.9%, $p = 0.030$) undergoing surgery for CD.

Conclusions Black patients are at increased risk of morbidity after surgery for both UC and CD. Increased morbidity in an already vulnerable population warrants targeted interventions, specifically focusing on faster access to specialized care, preoperative optimization, and culturally competent discussions on the benefits of MIS approaches are warranted in order to improve postoperative outcomes.

Keywords Racial groups · Healthcare disparities · Inflammatory bowel disease · Crohn's disease · Ulcerative colitis · Operative surgical procedure · Morbidity

Introduction

US census trends predict that 54% of the US population will be comprised of minorities by 2050, with Blacks and Hispanics contributing to 45% of the population,[1] along with reports of increasing incidence and prevalence of IBD among minorities.[2] Despite this, diversity in race reporting in large prospective studies, including national databases, remains low.[3,4]

Disparities in the management of inflammatory bowel disease (IBD) exist and have a multifactorial origin: insurance coverage, cost of care, access to specialists, delays in diagnosis, environmental factors (social, economic, and dietary), variable disease perception and self-management, as well as phenotypic and genetic differences are all potential causes of disparities in the treatment of IBD among different racial/ethnic groups.[5]

Black patients with Crohn's disease (CD) are most likely to experience complications related to their disease.[6] Hispanic patients are prescribed biologics and immunomodulators less often than their non-Hispanic-White

✉ Evangelos Messaris
emessari@bidmc.harvard.edu

Ana Sofia Ore
aore@bidmc.harvard.edu

[1] Division of Colorectal Surgery, Beth Israel Deaconess Medical Center, 330 Brookline Ave, Boston, MA, USA

counterparts.[7,8] Race-specific reported outcomes after surgery for IBD are variable, with some studies reporting no difference in utilization of surgery among racial/ethnic groups,[9–11] and some reporting Asian patients having more extended hospital stays, Hispanic patients having increased odds of readmission, and Black patients having the highest complication rates of all groups.[12]

With the continued rise in minority populations [13] and prevalence of IBD in these,[14] an increase in the number of minority patients reported in studies is fundamental, with the goal of accurately identifying racial/ethnic groups with risk of increased morbidity after surgery and outcomes that can be targeted. Due to the significant differences between ulcerative colitis (UC) and CD physiopathology, medical management, and indication for surgical resection, our aim is to conduct a targeted analysis evaluating postoperative morbidity among different racial/ethnic groups after surgical management of CD and UC independently while accounting for preoperative characteristics that may impact outcomes.

Material and Methods

Study Design

A retrospective cohort of patients undergoing elective surgical management with a diagnosis of UC and CD were identified using the National Surgical Quality Improvement (NSQIP) file from 2012 to 2019 and merged with the targeted proctectomy (2016–2019) and colectomy file (2012–2019). Participant user files included all procedures at participating centers or, in case of high volumes, algorithm-sampled cases.[15] Patients were reported as Non-Hispanic White (NHW), Black, Asian, or Hispanic White. Non-White patients identified as Hispanic were not included in the analysis as a separate group due to low numbers ($N=5$). Current procedural terminology (CPT) codes (Supplemental Table 1) were used to identify colorectal surgical procedures, and ICD9/ICD10 codes were used to identify patients diagnosed with CD and UC. Outcomes were analyzed by the intended surgical approach, open or minimally invasive (robotic or laparoscopic), regardless of conversion to open, to attribute the morbidity of conversion event to the selected surgical approach. Cases associated with a cancer diagnosis or missing race or ethnicity were excluded from the analysis. This study was exempt from Institutional Review Board approval.

Primary Outcome

The primary outcome was composite postoperative morbidity (CPM), a metric designed by the research team, based on previous studies,[16,17] confirming the efficacy of composite outcomes measuring postoperative morbidity when using ACS-NSQIP. The goal was to optimize sensitivity to identify postoperative morbidity. CPM was defined as one or more of these events in the first 30 postoperative days: organ/space surgical site infection, anastomotic leak, reoperation related to index procedure, sepsis/septic shock, pulmonary embolism, stroke or cerebrovascular accident, myocardial infarction, death or index length of stay longer than the 90th percentile. Length of stay longer than the 90th percentile was chosen as a proxy for postoperative complications impacting morbidity not available in the dataset.

Data Collection

Baseline characteristics were collected for all patients and included: demographic information (age, sex), along with body mass index (BMI), history of previous comorbidities: diabetes, hypertension, chronic obstructive pulmonary disease, use of tobacco, use of steroids in the preoperative period, preoperative albumin level, and American Society of Anesthesiologists physical status classification (ASA). Perioperative outcomes included surgical approach, operative time, ostomy formation, need for blood transfusion, reoperation rate, anastomotic leak rate, surgical and non-surgical complications (surgical site infection, urinary tract infection, pneumonia, venous thromboembolism, stroke, myocardial infarction, sepsis/septic shock, postoperative ileus), index length of stay, and readmission rate.

Statistical Analysis

Analyses were performed using STATA 15 (StataCorp 2017, Stata Statistical Software, Release 15, College Station, TX: Stata-Corp LLC). Data are reported utilizing the median (interquartile range) for continuous variables. Categorical variables are presented as percentages and counts. Kruskal Wallis test was used to compare differences among continuous variables, and X^2 was used for categorical variables. All tests were 2-sided with significance set at $p<0.05$. Multivariable logistic regression modeling was performed to evaluate factors associated with the primary outcome (CPM). Purposeful selection, along with a univariate screen ($p<0.1$) and backward elimination ($p<0.05$), was used. Models were tested using the area under the receiver operating curves (AUC).

For our secondary evaluation, propensity score modeling (PSM) with 1:1 matching without replacement was used to account for covariates that could affect postoperative outcomes. Each subject was selected randomly and then matched to the nearest subject with a caliper width of 0.2. Non-Hispanic White (NHW) patients were used as control and then matched to a patient from a different race/ethnicity. Covariates used in score matching included risk factors identified in the regression model and known variables impacting

IBD care: age, sex, tobacco use, BMI, preoperative steroid use, surgical approach (open, laparoscopic, robot-assisted), and preoperative albumin for both cohorts. For the UC cohort, the type of procedure performed (colectomy, proctectomy, total abdominal colectomy, proctocolectomy, pouch formation, ileostomy procedures) was included in PSM due to the diversity in procedures performed.

Results

Crohn's Disease

After inclusion and exclusion criteria, 12,043 patients were diagnosed with CD and underwent surgical resection. Out of all patients, 86.2% (10,386) identified as Non-Hispanic White (NHW), 9.9% (1186) as Black, 1.0% (125) as Asian, and 2.9% (346) as Hispanic. NHW (53.5%) and Black (54.5%) patients undergoing surgery were predominantly female, and Asian (60.0%) and Hispanic (50.3%) patients were predominantly male ($p<0.001$). Hispanic patients were younger at the time of resection (median age 33), followed by Asian (median age of 34), Black (median age of 35), and NHW patients (median age of 40) at surgical resection ($p<0.001$). BMI was higher in the NHW group (median 25) compared to a median of 24 for both Black and Hispanic patients and 22 for Asian patients ($p<0.001$). There was no difference in the rate of diabetes diagnosis among races/ethnicities. Black patients had the highest rate of smokers (27.6%, $p<0.001$). Preoperatively steroid use was highest among Asian (64.0%) and NHW patients (64.2%) and lowest in the Hispanic group (59.3%), with no significant difference ($p=0.228$). Albumin level as a measure of preoperative nutritional status was similar among races/ethnicities, lowest in the Black cohort (median 3.5) and highest in the NHW group (median 3.8, $p=0.234$) (Table 1).

CPM and Outcomes After Surgery for CD

CPM (Table 2) was highest for Black patients (27.5%, $N=326$), followed by Hispanic patients with a CPM of 21.1% ($N=73$); White and Asian patients, respectively, were found to have a CPM of 17.4% ($N=1810$) and 15.2% ($N=19$, $p<0.001$). After initial univariate screening, the final multivariable model evaluating factors associated with CPM included: age (OR 1.0, $p=0.559$), female gender (0.7, $p<0.001$) smoking status (OR 1.3, $p<0.001$), BMI (OR 0.99, $p=0.108$), steroid use (OR 1.0, $p=0.217$), minimally invasive surgical approach (OR 0.49, $p<0.001$) and preoperative albumin at normal (3.4 or higher) range (OR 0.47, $p<0.001$). Out of all races/ethnicities, only Black patients were found to have increased odds of CPM (OR 1.17, $p<0.001$). Asian patients were found to have decreased odds of CPM (OR 0.55, $p=0.040$) (Fig. 1). The model was found to have acceptable discrimination (AUC 0.704).

Table 3 details the perioperative outcomes following surgical resection. Black patients had the highest rate of open procedures (41.9%) when compared to NHW

Table 1 Preoperative characteristics of CD patients

	Non-Hispanic White ($N=10,386$)	Black ($N=1186$)	Asian ($N=125$)	Hispanic ($N=346$)	*P* value
Sex, % (*n*)					
Female	53.5% (5560)	54.5% (646)	40.0% (50)	49.7% (172)	<0.001
Male	46.5% (4826)	45.5% (540)	60.0% (75)	50.3% (174)	
Age (years), median (IQR)	40 (29–55)	35 (26–46)	34 (27.5–47)	33 (27–46)	<0.001
BMI, median (IQR)	25 (21–29)	24 (20–29)	22 (19–24)	24 (21–29)	<0.001
Diabetes, % (*n*)	3.4% (353)	3.4% (40)	4.0% (5)	3.5% (12)	0.988
Hypertension, % (*n*)	16.9% (1753)	18.7% (222)	12.8% (16)	10.4% (36)	0.002
COPD, % (*n*)	1.6% (168)	0.7% (8)	0% (0)	0.9% (3)	0.025
Smoker, % (*n*)	22.7% (2356)	27.6% (327)	14.4% (18)	19.4% (67)	<0.001
Preoperative Steroid Use, % (*n*)	64.2% (6667)	62.7% (744)	64.0% (80)	59.3% (205)	0.228
Preoperative Albumin Level, g/dL median (IQR)	3.8 (3.3–4.1)	3.5 (3.0–3.9)	3.7 (3.2–4.0)	3.6 (3.1–4.1)	<0.001
ASA class, % (*n*)					
I	1.5% (153)	0.6% (7)	3.2% (4)	2.3% (8)	0.017
II	58.8% (6100)	55.9% (663)	66.1% (82)	62.4% (216)	
III	38.3% (3980)	42.2% (500)	30.7% (38)	34.4% (119)	
IV	1.3% (139)	1.3% (15)	0% (0)	0.9% (3)	
V	0.1% (8)	0.1% (1)	0% (0)	0% (0)	

Table 2 Composite postoperative morbidity of Crohn's disease patients

Variables included in CPM % (*n*)	Non-Hispanic White	Black	Asian	Hispanic	*P* value
Organ/space SSI	7.1% (737)	9.4% (112)	7.2% (9)	7.8% (27)	0.033
Anastomotic leak	3.8% (396)	5.3% (63)	4.0% (5)	2.6% (9)	0.046
Reoperation	4.3% (443)	5.4% (64)	3.2% (4)	3.5% (12)	0.226
Sepsis/septic shock	2.3% (235)	4.5% (53)	2.4% (3)	2.6% (9)	< 0.001
Pulmonary embolism	0.5% (45)	0.7% (8)	0% (0)	0% (0)	0.334
Stroke or CVA	0.1% (11)	0% (0)	0% (0)	0% (0)	0.634
Myocardial infarction	0.2% (23)	0.2% (2)	0% (0)	0% (0)	0.762
Length of stay > 14 days (90th percentile)	9.7% (1003)	17.9% (212)	8.0% (10)	16.2% (56)	< 0.001
Death	0.3% (25)	0.3% (3)	0% (0)	0.3% (1)	0.952
Composite postoperative morbidity	17.4% (1810)	27.5% (326)	15.2% (19)	21.1% (73)	< 0.001

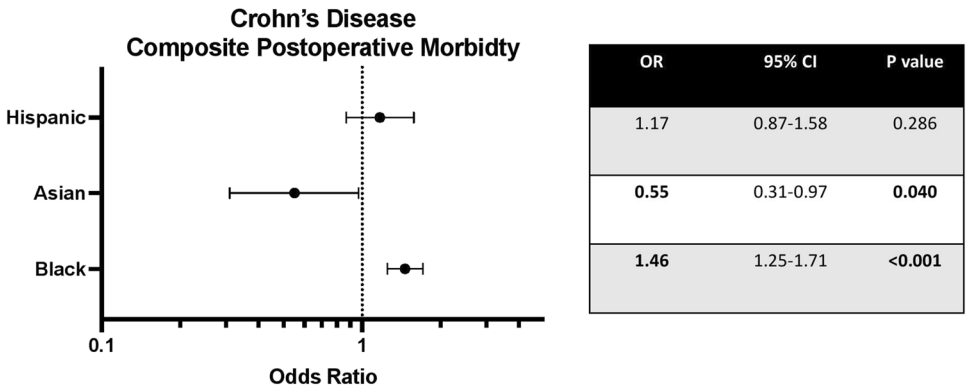

Fig. 1 Association between race/ethnicity and composite postoperative morbidity after surgery for CD

(35.0%), Asian (37.6%), and Hispanic (31.8%) patients ($p < 0.001$). The laparoscopic approach was predominantly used in all races/ethnicities, the highest for the Hispanic cohort (65.3%, $p < 0.001$). Operative time ranged between a median of 148 min (Asian cohort) and 158 min (Black cohort, $p < 0.001$).

After PSM analysis, operative time remained significantly longer for Black patients (median 158) when compared to their NHW counterparts (median 153, $p < 0.001$). Ostomy creation rates remained significantly elevated when comparing Asian (10.4%, p 0.010) and Hispanic (11.9%, $p = 0.030$) patients to their NHW counterparts (7.3%). Transfusion requirements remained elevated and statistically significant for Black patients (11.3%, $p = 0.031$), along with a higher rate of deep/organ space infections (9.4% Black patients vs. 7.1% NHW patients, $p = 0.040$). Length of stay remained longer for Black patients compared to their NHW counterparts (median 6 days vs. 5 days, $p = 0.034$).

Ulcerative Colitis

UC was diagnosed in 6699 patients; 87.3% identified as NHW (5,850), 4.6% (310) as Black, 2.2% (146) as Asian, and 5.9% (393) as Hispanic. NHW (53.5%) and Black (54.5%) patients were predominantly female, while Asian (60.0%) and Hispanic (50.3%) patients were predominantly male ($p < 0.001$). Hispanic patients were younger at surgical resection with a median age of 33, followed by Asian patients with a median age of 34. NHW patients were significantly older at resection, with a median age of 40 ($p < 0.001$). NHW patients had a median BMI of 25, compared to a median of 24 for the Black and Hispanic cohorts; Asian patients had the lowest BMI with a median of 22 ($p < 0.001$). Black patients had a significantly higher rate of hypertension (18.7%) compared to other cohorts ($p < 0.001$). Additionally, they had the highest rate of smokers with 27.6% when compared to NHW (22.7%), Hispanic (19.4%), and Asian (14.4%) patients ($p < 0.0014$). Preoperative steroid use was lowest for Hispanic patients, with a rate of 59.3%. Preoperative albumin level was lowest for Black patients with a median of 3.5, compared to 3.6 for Hispanic patients, 3.7 for Asian patients, and 3.8 for NHW patients ($p < 0.001$). Due to the vast number of procedures used in UC and a significant difference in the number of procedures performed by race (Table 4), type of procedure was included in the analysis for both primary and secondary outcomes.

Although not included in the analysis, the rate of emergent procedures for UC was significantly higher for Black patients (15.1%), followed by Hispanic patients (12.3%), with the lowest rate of emergent procedures being for White patients (8.9%,

Table 3 Perioperative outcomes after surgery for CD patients

Outcomes	Non-Hispanic White ($N=10,386$)	Black ($N=1186$)	Asian ($N=125$)	Hispanic ($N=346$)	P value	PSM adjusted analysis		
						Black	Asian	Hispanic
Surgical approach, % (n)								
Open	35.0% (3636)	41.9% (497)	37.6% (47)	31.8% (110)	< 0.001	0.734	0.250	0.173
Laparoscopic	61.2% (6351)	54.1 (642)	60.0% (75)	65.3% (226)	< 0.001	0.015	0.315	0.190
Robotic	3.8% (399)	3.9% (47)	2.4% (3)	2.9% (10)	0.664	0.126	0.736	0.684
Operative time (min), median (IQR)	153 (114–206)	158 (118–214)	148 (117–202)	155 (114–206)	< 0.001	< 0.001	0.209	0.224
Ostomy formation, % (n)	7.3% (756)	8.4% (99)	10.4% (13)	11.9% (41)	0.005	0.491	0.010	0.030
Reoperation rate, % (n)	4.3% (443)	5.4% (64)	3.2% (4)	3.5% (12)	0.234	0.260	0.896	0.547
Need for transfusion, % (n)	6.6% (688)	11.3% (134)	6.4% (8)	11.3% (39)	< 0.001	0.031	0.235	0.332
Surgical site infection, % (n)								
Superficial	0.3% (29)	0.3% (3)	0% (0)	0.6% (2)	0.690	0.531	NA	0.368
Deep	0.2% (19)	0% (0)	0% (0)	0% (0)	0.386	NA	NA	NA
Organ/space	7.1% (737)	9.4% (112)	7.2% (9)	7.8% (27)	0.033	0.040	0.490	0.477
Urinary tract infection, % (n)	0.1% (14)	0.3% (3)	0% (0)	0% (0)	0.627	0.938	NA	NA
Pneumonia, % (n)	1.2% (126)	1.2% (14)	0% (0)	1.5% (5)	0.636	0.630	NA	0.731
Venous thromboembolism, % (n)	1.6% (162)	1.5% (18)	2.4% (3)	1.2% (4)	0.812	0.938	0.524	0.302
Stroke, % (n)	0.1% (11)	0% (0)	0% (0)	0% (0)	0.624	NA	NA	NA
Myocardial infarction, % (n)	0.2% (23)	0.2% (2)	0% (0)	0% (0)	0.762	0.105	NA	NA
Sepsis, % (n)	2.3% (235)	4.5% (53)	2.4% (3)	2.6% (9)	< 0.001	0.089	0.932	0.716
Anastomotic leak, % (n)	3.8% (396)	5.3% (63)	4.0% (5)	2.6% (9)	0.046	0.070	0.349	0.459
Ileus, % (n)	14.8% (1535)	18.6% (221)	16.0% (20)	13.3% (46)	0.004	0.068	0.402	0.524
Length of stay, days (IQR)	5 (3–8)	6 (4–12)	6 (4–8)	5 (4–9)	< 0.001	< 0.001	0.754	0.189
Readmission, % (n)	12.1% (1251)	12.9% (153)	9.6% (12)	13.0% (45)	0.630	0.509	0.923	0.306
Multiple readmissions (+2), % (n)	0.8% (91)	1.5% (18)	0.8% (1)	2.0% (7)	0.034	0.654	0.196	0.899

$p<0.001$). The emergent procedures for CD was significantly higher for Asian patients (10.4%), followed by Hispanic patients (8.4%), with the lowest rate of emergent procedures being for Black (6.1%) and White patients (5.1%, $p<0.001$).

CPM and Outcomes After Surgery for UC

CPM (Table 5) was highest for Black patients (26.1%, $N=81$), followed by Asian patients with a CPM of 21.2% ($N=31$); White and Hispanic patients, respectively, were found to have a CPM of 18.2% and 17.8% ($p=0.005$). After initial univariate screening, the final multivariable model evaluating factors associated with CPM included age (OR 1.0, 0.107), female gender (OR 0.85, $p=0.040$), smoking status (OR 1.34, $p=0.031$), BMI (OR 1.01, $p=0.032$), steroid use (OR 0.98, $p=0.830$), minimally invasive surgical approach (OR 0.82, $p=0.009$), and preoperative albumin at normal (3.4 or higher) range (OR 0.40, $p<0.001$). Black patients had increased CPM odds (OR 1.48, $p=0.013$) (Fig. 2). The model was found to have acceptable discrimination (AUC 0.707).

On unadjusted analysis, Black patients had a higher rate of open procedures (31.6%, $p=0.020$), and Hispanic patients had a higher rate of robotic procedures (14.5%, $p<0.001$). After PSM, length of stay remained significantly longer for Black patients (median 7 days) compared to their NHW counterparts (5 days, $p=0.050$). Additionally, readmission rates also remained substantially higher for Black patients with a rate of 21.6%, when compared to 17.0% in NHW patients ($p<0.001$) (Table 6).

Discussion

This retrospective study aimed to evaluate the association between race/ethnicity and morbidity after elective surgery for IBD. We identified an increased risk of CPM for

Table 4 Perioperative characteristics of UC patients

	Non-Hispanic White (N = 5850)	Black (N = 310)	Asian (N = 146)	Hispanic (N = 393)	*P* value
Sex, % (*n*)					
Female	44.8% (2619)	49.4% (153)	39.1% (57)	42.0% (165)	0.122
Male	55.2% (3231)	50.6% (157)	60.9% (89)	58.0% (228)	
Age (years), median (IQR)	42 (30–58)	41 (29–56)	39 (31–53)	34 (25–46)	< 0.001
BMI, median (IQR)	25 (22–30)	26 (22–31)	24 (20–26)	26 (22–30)	< 0.001
Diabetes, % (*n*)	7.5% (439)	10.0% (31)	8.9% (13)	5.3% (21)	0.121
Hypertension, % (*n*)	19.6% (1144)	25.2% (78)	13.7% (20)	11.2% (44)	< 0.001
COPD, % (*n*)	1.8% (106)	0.9% (3)	0.7% (1)	0% (0)	0.025
Smoker, % (*n*)	6.9% (401)	10% (31)	2.7% (4)	5.1 (20)	0.014
Preoperative steroid use, % (*n*)	54.0% (3161)	50.3% (156)	52.1% (76)	53.7% (211)	0.611
Preoperative albumin level, g/dL median (IQR)	3.6 (2.9–4.1)	3.3 (2.5–3.9)	3.5 (3–4.2)	3.6 (2.8–4.1)	< 0.001
ASA class, % (*n*)					
I	1.2% (70)	1.0% (3)	2.1% (3)	1.3% (5)	< 0.001
II	51.9% (3036)	42.0% (130)	53.4% (78)	58.7% (231)	
III	44.7% (2620)	52.9% (164)	43.1% (63)	38.2% (150)	
IV	2.1% (121)	3.8% (12)	1.4% (2)	1.5% (6)	
V	0.1% (3)	0.3% (1)	0% (0)	0.3% (1)	
Procedure performed, % (*n*)					
Colectomy	9.5% (557)	13.5% (42)	8.2% (12)	9.6% (38)	0.029
Proctectomy	15.4% (898)	11.6% (36)	16.5% (24)	12.0% (47)	0.030
TAC w/o proctectomy	48.5% (2837)	52.3% (162)	45.2% (66)	46.3% (182)	0.366
Proctocolectomy	5.7% (335)	2.6% (8)	4.1% (6)	3.8% (15)	0.037
Pouch procedures	18.4% (1079)	17.4% (54)	22.6% (33)	22.7% (89)	0.037
Ileostomy procedures	2.5% (144)	2.6% (8)	3.4% (5)	5.6% (22)	< 0.001

Table 5 Composite postoperative morbidity of ulcerative colitis patients

Variables included in CPM % (*n*)	Non-Hispanic White	Black	Asian	Hispanic	*P* value
Organ/space SSI	7.1% (415)	9.0% (28)	8.2% (12)	9.2% (36)	0.271
Anastomotic Leak	2.4% (143)	3.2% (10)	2.1% (3)	2.8% (11)	0.799
Reoperation	5.6% (330)	9.0% (28)	5.5% (8)	5.9% (23)	0.101
Sepsis/Septic Shock	1.1% (65)	3.2% (10)	0.7% (1)	0.8% (3)	0.007
Pulmonary Embolism	0.7% (42)	0.7% (2)	0% (0)	0.3% (1)	0.531
Stroke or CVA	0.1% (7)	0% (0)	0% (0)	0.3% (1)	0.766
Myocardial Infarction	0.2% (10)	0% (0)	0% (0)	0.3% (1)	0.811
Length of Stay > 14 Days (90^{th} Percentile)	9.3% (541)	16.1% (50)	13.0% (19)	6.6% (26)	< 0.001
Death	0.4% (24)	0% (0)	0% (0)	0% (0)	0.321
Composite Postoperative Morbidity	18.2% (1065)	26.1% (81)	21.2% (31)	17.8% (70)	0.005

Black patients after surgery for CD and UC, along with a decreased risk of morbidity for Asian patients undergoing surgery for UC. The goal of using CPM was to maximize statistical power to detect morbidity events that can impact patient recovery after surgery. Each component of CPM was weighted equally and served a role in evaluating postoperative morbidity.

IBD impacts the quality of life of all patients, but vulnerable populations are affected at a higher rate throughout all stages of treatment. Multiple reports state a higher risk of complications for minority patients, along with years of

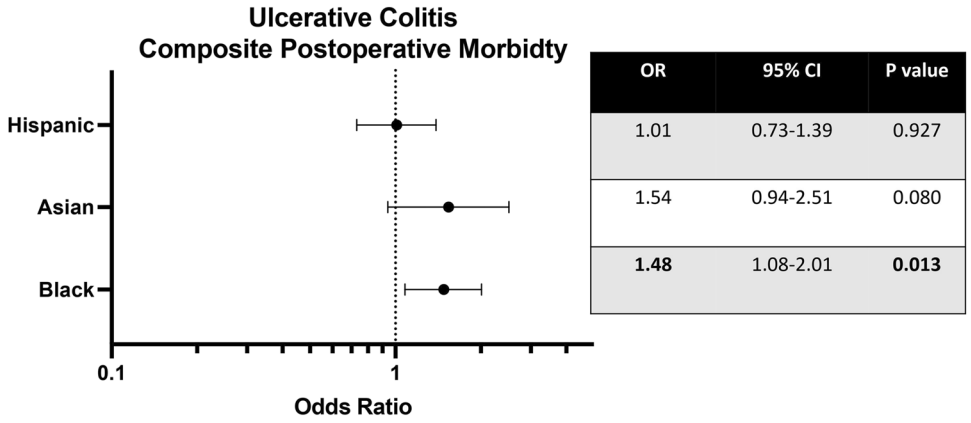

Fig. 2 Association between race/ethnicity and composite postoperative morbidity after surgery for UC

Table 6 Perioperative outcomes after surgery for UC

Outcomes	Non-Hispanic White ($N=5850$)	Black ($N=310$)	Asian ($N=146$)	Hispanic ($N=393$)	P value	PSM adjusted analysis		
						Black	Asian	Hispanic
Surgical approach, % (n)								
Open	27.3% (1594)	31.6% (98)	21.2% (31)	20.4% (80)	0.002	0.054	0.066	0.227
Laparoscopic	64.7% (3786)	57.1% (177)	63.7% (93)	65.1% (256)	0.055	0.446	0.170	0.096
Robotic	8.0% (470)	11.3% (35)	15.1% (22)	14.5% (57)	< 0.001	0.523	0.676	0.049
Operative time (min), median (IQR)	209 (158–279)	206 (154–280)	217 (161–295)	210 (165–292)	0.264	0.093	0.760	0.743
Reoperation rate, % (n)	5.6% (330)	9.0% (28)	5.5% (8)	5.9% (23)	0.101	0.762	0.921	0.815
Need for transfusion, % (n)	3.6% (210)	8.1% (25)	5.5% (8)	3.6% (14)	0.001	0.109	0.880	0.774
Surgical site infection, % (n)								
Superficial	0.1% (7)	0.3% (1)	0% (0)	0% (0)	0.633	0.799	NA	NA
Deep	0.1% (3)	0% (0)	0% (0)	0% (0)	0.933	NA	NA	NA
Organ/space	7.1% (415)	9.0% (28)	8.2% (12)	9.2% (36)	0.271	0.945	0.780	0.271
Urinary tract infection, % (n)	0.12 (7)	0% (0)	0% (0)	0.3% (1)	0.766	NA	NA	NA
Pneumonia, % (n)	1.6% (94)	0.9% (3)	0.7% (1)	1.8% (7)	0.652	0.171	NA	0.377
Venous thromboembolism, % (n)	3.5% (206)	3.9% (12)	2.7% (4)	2.5% (10)	0.698	0.402	< 0.001	0.186
Stroke, % (n)	0.1% (7)	0% (0)	0% (0)	0.3% (1)	0.766	NA	NA	NA
Myocardial infarction, % (n)	0.2% (10)	0% (0)	0% (0)	0.3% (1)	0.811	NA	NA	NA
Sepsis, % (n)	1.1% (65)	3.2% (10)	0.7% (1)	0.8% (3)	0.007	0.503	NA	0.252
Anastomotic leak, % (n)	2.4% (143)	3.2% (10)	2.1% (3)	2.8% (11)	0.799	0.722	0.144	0.559
Ileus, % (n)	17.0% (996)	18.4% (57)	17.1% (25)	16.5% (65)	0.926	0.832	0.452	0.110
Length of stay, days (IQR)	5 (4–10)	7 (4–14)	6 (4–11)	6 (4–10)	< 0.001	0.050	0.238	0.935
Readmission, % (n)	17.0% (997)	21.6% (67)	15.1% (22)	19.3% (76)	0.115	< 0.001	0.206	0.320
Multiple readmissions (+2), % (n)	1.9% (113)	3.2% (10)	3.4% (5)	2.3% (9)	0.257	0.094	0.651	0.676

delayed reporting of outcomes due to the belief of a lower prevalence of IBD in other races/ethnicities.[18] Black patients have a threefold higher risk of ED visits than their White counterparts.[8] Hispanic patients are more likely to have emergency surgery compared to other groups.[12] Mixed evidence exists regarding patients of different races/ethnicity having similar disease presentations and course.[19–22] Social and economic factors have been identified as the source of disparities in care, along with an increased risk of low health literacy.[13] All these factors impact access to surgery, preoperative optimization, and postoperative surgical outcomes.

Our results showed that when matching for known preoperative variables that may impact postoperative morbidity, Black patients are the most vulnerable to worse

outcomes. Despite adjusting for surgical approach, required due to Black patients undergoing more open procedures, outcomes were still worse for this group. Longer operative times, increased transfusion requirements, and a longer index length of stay, which have been previously reported, were also found and confirmed with PSM.[12,23,24]

A recent analysis by Xu et al. [14] reinforces that the highest increase in prevalence for CD and UC is among non-Hispanic Black patients, with a 5% annual percentage increase for CD and 3.5% for UC between 2001 and 2018. Previous studies have confirmed that Black patients have limited access to gastroenterologists and IBD specialists, [8] which translates to delays in diagnosis and appropriate IBD care. Phenotypically, IBD presents in its most aggressive forms in Black patients [6], despite this, access to biologic agents remains significantly lower for Black, Hispanic, and Asian patients,[8,25] which can explain an increased level of complexity when requiring surgical management.

Reduced access to specialty care, limited knowledge on available resources and lack of trust of minority groups of predominantly white physicians [26] lead to delays in diagnosis, access to care and poorly optimized patients before undergoing surgical management.[27] Black patients had higher smoking rates and lower preoperative albumin levels. With knowledge that these factors may lead to worse postoperative outcomes [28] and increased morbidity,[29] our evidence suggests that preoperative optimization of Black patients should start at an earlier time, and efforts should be made to counsel, discuss, and explain the reasoning behind why smoking discontinuation and improved nutrition should occur before surgery.

Minimally invasive approaches were also found to decrease the risk of CPM; despite this, Black patients were found to have higher rates of open surgical procedures. Along with preoperative optimization, and improving access to medical management before surgery, benefits of minimally invasive approaches should be discussed thoroughly, especially for elective procedures. Minority patients, due to insufficient data on clinical effectiveness of treatment options in their populations, lack of education on how to manage their disease [30], can understandably be hesitant and lack trust on minimally invasive approaches. Efforts should be made to provide culturally competent discussions regarding their disease and treatment.

Increased stoma creation rates for Hispanic and Asian patients were also identified and confirmed after PSM with their NHW counterparts. Evidence shows that outcomes for minority patients undergoing stoma formation after colorectal surgery are worse and include increased postoperative complications and prolonged hospital stays.[31] Knowing all this, are we accounting for all factors involved in their care before deciding on surgical approach and stoma creation?

Our study had the established limitations of a retrospective analysis using a nationwide cohort, including the risk of selection bias, unmeasured confounding, and missing cases based on CPT codes. Specific limitations of using ACS-NSQIP for IBD research include the lack of data on the use of biologics and immunomodulators before surgery, along with information regarding their medical care (specialist or not), insurance status, the level of social support a patient has and lack of variables identifying surgery referral and access to surgical care. Due to lack of targeted NSQIP variables for small bowel resections, these were excluded from the analysis. Despite this, the strength of this study is based on accounting for all available variables that may impact morbidity and postoperative care, with the use of multivariable regression modeling for our primary outcome (CPM) and a PSM analysis for all secondary outcomes to determine the specific difference in outcomes of each race/ethnicity compared to their NHW counterparts.

Actionable items such as expediting access to surgery, providing access to specialized surgical IBD care for adequate decision making on surgical approach and preoperative optimization due to minority patients having a higher rate of comorbidities are needed to decrease postoperative morbidity. Additionally, efforts should be directed at increasing reported outcomes of minority patients with IBD. With numbers showing an increased number of Black and Hispanic citizens overall in the USA and a higher incidence of IBD in minorities, why are we not increasing the number of minority patients reported in clinical trials and large databases?

Conclusion

Black patients are at increased risk of morbidity after surgery for UC and CD. Even after adjusting for variables impacting postoperative care, postoperative morbidity remained elevated for Black patients. Hispanic and Asian patients were found to have increased stoma creation rates, despite accounting for preoperative variables that may impact decision-making. Increased morbidity in an already vulnerable population warrants targeted interventions, specifically focusing on faster access to specialized care, preoperative optimization, and culturally competent discussions on the benefits of MIS approaches are warranted in order to improve outcomes. Additionally, increasing the number of minority patients reported in research involving all stages of IBD care is necessary and would help identify further areas to target.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11605-022-05483-x.

Declarations

Competing Interests The authors declare no competing interests.

References

1. Bureau UC. National Population Projections Datasets. 2017. https://www.census.gov/data/datasets/2017/demo/popproj/2017-popproj.html. Accessed 15 Jan 2022
2. Afzali A, Cross RK. Racial and Ethnic Minorities with Inflammatory Bowel Disease in the United States: A Systematic Review of Disease Characteristics and Differences. *Inflamm Bowel Dis*. 2016;22(8):2023-2040. https://doi.org/10.1097/MIB.0000000000000835
3. Sewell JL, Velayos FS. Systematic review: The role of race and socioeconomic factors on IBD healthcare delivery and effectiveness. *Inflamm Bowel Dis*. 2013;19(3):627-643. https://doi.org/10.1002/ibd.22986
4. Lattimer LDN, Chandler MB, Borum ML. Hispanics and inflammatory bowel disease. *Inflamm Bowel Dis*. 2015;21(5):1214-1218. https://doi.org/10.1097/MIB.0000000000000300
5. Barnes EL, Loftus EVJ, Kappelman MD. Effects of Race and Ethnicity on Diagnosis and Management of Inflammatory Bowel Diseases. *Gastroenterology*. 2021;160(3):677-689. https://doi.org/10.1053/j.gastro.2020.08.064
6. Barnes EL, Kochar B, Long MD, et al. Lack of difference in treatment patterns and clinical outcomes between Black and White patients with inflammatory bowel disease. *Inflamm Bowel Dis*. 2018;24(12):2634-2640. https://doi.org/10.1093/IBD/IZY179
7. Damas OM, Jahann DA, Reznik R, et al. Phenotypic manifestations of inflammatory bowel disease differ between Hispanics and non-Hispanic Whites: Results of a large cohort study. *Am J Gastroenterol*. 2013;108(2):231-239. https://doi.org/10.1038/ajg.2012.393
8. Nguyen GC, LaVeist TA, Harris ML, Wang M-H, Datta LW, Brant SR. Racial disparities in utilization of specialist care and medications in inflammatory bowel disease. *Am J Gastroenterol*. 2010;105(10):2202-2208. https://doi.org/10.1038/ajg.2010.202
9. Sewell JL, Inadomi JM, Yee HF. Race and inflammatory bowel disease in an urban healthcare system. *Dig Dis Sci*. 2010;55(12):3479-3487. https://doi.org/10.1007/s10620-010-1442-8
10. Li D, Collins B, Velayos FS, et al. Racial and ethnic differences in health care utilization and outcomes among ulcerative colitis patients in an integrated health-care organization. *Dig Dis Sci*. 2014;59(2):287-294. https://doi.org/10.1007/s10620-013-2908-2
11. Flasar MH, Quezada S, Bijpuria P, Cross RK. Racial differences in disease extent and severity in patients with ulcerative colitis: A retrospective cohort study. *Dig Dis Sci*. 2008;53(10):2754-2760. https://doi.org/10.1007/s10620-007-0190-x
12. Dos Santos Marques IC, Theiss LM, Wood LN, et al. Racial disparities exist in surgical outcomes for patients with inflammatory bowel disease. *Am J Surg*. 2021;221(4):668-674. https://doi.org/10.1016/j.amjsurg.2020.12.010
13. Dos Santos Marques IC, Theiss LM, Baker SJ, et al. Low Health Literacy Exists in the Inflammatory Bowel Disease (IBD) Population and Is Disproportionately Prevalent in Older African Americans. *Crohn's Colitis 360*. 2020;2(4):1–7. https://doi.org/10.1093/crocol/otaa076
14. Xu F, Carlson SA, Liu Y, Greenlund KJ. Prevalence of Inflammatory Bowel Disease Among Medicare Fee-For-Service Beneficiaries — United States, 2001−2018. *MMWR Recomm Reports*. 2021;70(19):698-701. https://doi.org/10.15585/mmwr.mm7019a2
15. Steinberg SM, Popa MR, Michalek JA, Bethel MJ, Ellison EC. Comparison of risk adjustment methodologies in surgical quality improvement. *Surgery*. 2008;144(4):662-667. https://doi.org/10.1016/j.surg.2008.06.010
16. Klompmaker S, van Zoggel D, Watkins AA, et al. Nationwide Evaluation of Patient Selection for Minimally Invasive Distal Pancreatectomy Using American College of Surgeons' National Quality Improvement Program. *Ann Surg*. 2016;266(6):1. https://doi.org/10.1097/SLA.0000000000001982
17. Ore AS, Barrows CE, Solis-Velasco M, Shaker J, Moser AJ. Robotic enucleation of benign pancreatic tumors. *J Vis Surg*. 2017;3(I):151–151. https://doi.org/10.21037/jovs.2017.08.15
18. Simsek H, Schuman BM. Inflammatory bowel disease in 64 black patients: analysis of course, complications, and surgery. *J Clin Gastroenterol*. 1989;11(3):294-298. https://doi.org/10.1097/00004836-198906000-00010
19. Straus WL, Eisen GM, Sandler RS, Murray SC, Sessions JT. Crohn's disease: does race matter? The Mid-Atlantic Crohn's Disease Study Group. *Am J Gastroenterol*. 2000;95(2):479-483. https://doi.org/10.1111/j.1572-0241.2000.t01-1-01531.x
20. Sofia MA, Rubin DT, Hou N, Pekow J. Clinical presentation and disease course of inflammatory bowel disease differs by race in a large tertiary care hospital. *Dig Dis Sci*. 2014;59(9):2228-2235. https://doi.org/10.1007/s10620-014-3160-0
21. Nguyen GC, Torres EA, Regueiro M, et al. Inflammatory bowel disease characteristics among African Americans, Hispanics, and non-Hispanic Whites: Characterization of a large North American cohort. *Am J Gastroenterol*. 2006;101(5):1012-1023. https://doi.org/10.1111/j.1572-0241.2006.00504.x
22. Moore L, Gaffney K, Lopez R, Shen B. Comparison of the natural history of ulcerative colitis in African Americans and non-Hispanic Caucasians: A historical cohort study. *Inflamm Bowel Dis*. 2012;18(4):743-749. https://doi.org/10.1002/ibd.21796
23. Gunnells DJ, Morris MS, DeRussy A, et al. Racial Disparities in Readmissions for Patients with Inflammatory Bowel Disease (IBD) After Colorectal Surgery. *J Gastrointest Surg*. 2016;20(5):985-993. https://doi.org/10.1007/s11605-015-3068-9
24. Galoosian A, Rezapour M, Liu B, Bhuket T, Wong RJ. Race/ethnicity-specific disparities in in-hospital mortality and hospital charges among inflammatory bowel disease-related hospitalizations in the United States. *J Clin Gastroenterol*. 2020;54(7):E63-E72. https://doi.org/10.1097/MCG.0000000000001204
25. Flasar MH, Johnson T, Roghmann MC, Cross RK. Disparities in the use of immunomodulators and biologics for the treatment of inflammatory bowel disease: A retrospective cohort study. *Inflamm Bowel Dis*. 2008;14(1):13-19. https://doi.org/10.1002/ibd.20298
26. Jackson JF, Kornbluth A. Do Black and Hispanic Americans with inflammatory bowel disease (IBD) receive inferior care compared with White Americans? Uneasy questions and speculations. *Am J Gastroenterol*. 2007;102(7):1343-1349. https://doi.org/10.1111/j.1572-0241.2007.01371.x
27. Damas OM, Kuftinec G, Khakoo NS, et al. Social barriers influence inflammatory bowel disease (IBD) outcomes and

disproportionally affect Hispanics and non-Hispanic Blacks with IBD. *Therap Adv Gastroenterol*. 2022;15:1-14. https://doi.org/10.1177/17562848221079162
28. Cosnes J. Smoking and Diet: Impact on Disease Course? *Dig Dis*. 2016;34(1-2):72-77. https://doi.org/10.1159/000442930
29. Patel K V, Darakhshan AA, Griffin N, Williams AB, Sanderson JD, Irving PM. Patient optimization for surgery relating to Crohn's disease. *Nat Rev Gastroenterol Hepatol*. 2016;13(12):707-719. https://doi.org/10.1038/nrgastro.2016.158
30. Liu JJ, Abraham BP, Adamson P, et al. The Current State of Care for Black and Hispanic Inflammatory Bowel Disease Patients. Inflamm Bowel Dis. 2022;izac124. https://doi.org/10.1093/ibd/izac124
31. Sharp SP, Ata A, Chismark AD, et al. Racial disparities after stoma construction in colorectal surgery. *Color Dis*. 2020;22(6):713-722. https://doi.org/10.1111/codi.14943