Inequities in surgical outcomes by race and sex in the United States: retrospective cohort study

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ABSTRACT

OBJECTIVE
To assess inequities in mortality by race and sex for eight common surgical procedures (elective and non-elective) across specialties in the United States.

DESIGN
Retrospective cohort study.

SETTING
US, 2016-18.

PARTICIPANTS
1 868 036 Black and White Medicare beneficiaries aged 65-99 years undergoing one of eight common surgeries: repair of abdominal aortic aneurysm, appendectomy, cholecystectomy, colectomy, coronary artery bypass surgery, hip replacement, knee replacement, and lung resection.

MAIN OUTCOME MEASURE
The main outcome measure was 30 day mortality, defined as death during hospital admission or within 30 days of the surgical procedure.

RESULTS
Postoperative mortality overall was higher in Black men (1698 deaths, adjusted mortality rate 3.05%, 95% confidence interval 2.85% to 3.24%) compared with White men (21 833 deaths, 2.69%, 2.65% to 2.73%), White women (21 847 deaths, 2.38%, 2.35% to 2.41%), and Black women (1631 deaths, 2.18%, 2.04% to 2.31%), after adjusting for potential confounders. A similar pattern was found for elective surgeries, with Black men showing a higher adjusted mortality (393 deaths, 1.30%, 1.14% to 1.46%) compared with White men (5650 deaths, 0.85%, 0.83% to 0.88%), White women (4615 deaths, 0.82%, 0.80% to 0.84%), and Black women (359 deaths, 0.79%, 0.70% to 0.88%). This 0.45 percentage point difference implies that mortality after elective procedures was 50% higher in Black men compared with White men. For non-elective surgeries, however, mortality did not differ between Black men and White men (1305 deaths, 6.69%, 6.26% to 7.11%; and 16 183 deaths, 7.03%, 6.92% to 7.14%, respectively), although mortality was lower for White women and Black women (17 232 deaths, 6.12%, 6.02% to 6.21%; and 1272 deaths, 5.29%, 4.93% to 5.64%, respectively). These differences in mortality appeared within seven days after surgery and persisted for up to 60 days after surgery.

CONCLUSIONS
Postoperative mortality overall was higher among Black men compared with White men, White women, and Black women. These findings highlight the need to understand better the unique challenges Black men who require surgery face.

WHAT IS ALREADY KNOWN ON THIS TOPIC
Racial inequities exist in surgical care and outcomes, including higher postoperative mortality among Black patients

Information on how such outcomes differ by race and sex is limited

WHAT THIS STUDY ADDS
Postoperative mortality overall was higher among Black men compared with White men, White women, and Black women, after adjusting for potential confounders

Mortality was 50% higher for Black men than for White men after elective surgeries

The differential distribution of patients across surgeons accounted for about one third of the inequity in elective surgical mortality between Black men and White men

Introduction
Reducing racial inequities remains a central priority of the US healthcare system.[1] Racial inequities in surgical care and outcomes, including a higher postoperative mortality among Black patients undergoing a surgical procedure,[2-6] and some narrowing of such inequities,[7] have been well documented. Studies outside of surgical care and outcomes have found a complex interplay between race and sex, with Black men exhibiting a shorter life expectancy.[8] Although informative, evidence is limited as to how surgical outcomes differ by race and sex.

Inequities in surgery related mortality by race and sex can be multifactorial and associated with factors such as poor access to high quality healthcare and differences in care that influence disease severity and health status before surgery.[9-12] Additionally, preoperative management may play a role. For elective procedures, surgeons have more opportunity to both optimize patients (eg, improve management of chronic diseases such as diabetes and hypertension) before surgery and choose (or avoid) patients. Therefore, inequities that occur for a procedure performed electively, but not for the same procedure performed urgently or emergently, may suggest preoperative factors, such as differences in preoperative optimization or in referral patterns, play a large role.[10 13] Given increasing interest in trying to understand the underlying mechanisms that result in inequities in surgical care and outcomes, an important first step is to elucidate whether the relationship between race and sex and surgical outcomes varies between patients who undergo elective surgeries and those who require non-elective (urgent and emergent) surgeries.

In this context, we used nationwide data on older Medicare fee-for-service beneficiaries from 2016 to 2018 to examine whether there were inequities in mortality by subgroups of race and sex across eight common surgical procedures. We also examined whether these inequities differed by procedure acuity (ie, urgency of surgery): elective or non-elective. Mortality rates were then studied longitudinally to examine how any inequities evolved over time.

Methods

Data sources and study population

We used 2016-18 data on Medicare fee-for-service beneficiaries from the 100% Medicare inpatient file. Our sample was restricted to those aged 65-99 years[14] who were continuously enrolled in Medicare Parts A and B in a given year and underwent one of eight common surgical procedures (these eight procedures were chosen to be comparable to recent work, which examined the same eight procedures together)[7]: repair of abdominal aortic aneurysm, appendectomy, cholecystectomy, colectomy, coronary artery bypass surgery, hip replacement, knee replacement, and lung resection (see supplementary table A for ICD-10 procedure codes used to identify each surgery).

We analyzed four subgroups of race and sex: Black men, White men, White women, and Black women. Race was self-reported, with options defined by the data source. We a priori focused on inequities in surgical mortality between Black and White individuals for three reasons: to be comparable to recent literature on racial inequities in surgical care and outcomes,[7 15 16] to study the two largest racial groups in Medicare for which the race variable has been validated,[17] and because of the unique effects of structural racism on Black individuals in the United States.[18] However, in sensitivity analyses, we also examined Hispanic patients.

Outcome measures

Our primary outcome was 30 day mortality (the index date being the date of surgery), defined as death during hospital admission or within 30 days of the surgical procedure. The Medicare Beneficiary Summary File was used for date of death, which is verified using death certificates. Overall, 99% of death days have been validated in the Medicare data,[19] and we excluded patients whose death days had not been validated (therefore our data were not censored). To examine how inequities in surgical mortality by race and sex evolve over time after the surgical procedure, we also examined 7 day, 14 day, and 60 day mortality rates. To allow for sufficient follow-up after surgery, we excluded patients who underwent procedures in the last 7, 14, 30, and 60 days of our data.

Covariates

We identified acuity of surgery based on the admission type code variable, with elective defined by a code of “elective” and non-elective defined by a code of “urgent” or “emergency.”[7 14 20-24] The surgeon performing the procedure was identified from the operating physician field of the inpatient claim.[14]

In addition to race and sex, patient covariates included age (defined categorically in five year age groups), dual eligibility for Medicaid (as an indicator for socioeconomic status because only individuals with low income are eligible for Medicaid coverage in the US), disability as the original reason for Medicare eligibility, and 27 chronic conditions (see table 1) found in the Medicare Master Beneficiary Summary File. The patient covariates are measured concurrently on date of surgery, with the 27 chronic conditions defined from validated algorithms by the Center for Medicare and Medicaid Services using different lookback periods.[25] The geographic unit controlled for was hospital service area, which are relatively self-contained areas with respect to hospital care. We used a geographic unit smaller than the state to control for differences across areas within the same state.[26] To control for differences between surgical procedures performed on the weekend versus weekday, we included a binary variable for weekend (versus weekday). We also adjusted for month fixed effects to control for seasonality in surgical mortality, and year fixed effects to control for temporal trends in surgical mortality.

Statistical analysis

In the first set of analyses, we estimated a multivariable linear regression (linear probability model) of 30 day mortality rate for all eight surgical procedures (repair of abdominal aortic aneurysm, appendectomy, cholecystectomy, colectomy, coronary artery bypass surgery, hip replacement, knee replacement, and lung resection) as a function of race and sex, with the patient, geographic unit, and time variables listed (age, Medicaid dual eligibility, disability, 27 chronic conditions, hospital service area fixed effects, weekend surgery, month fixed effects, and year fixed effects) along with procedure fixed effects, all included as covariates in the model. Using this specification, we ran this regression separately three times: for the eight procedures when performed electively (elective procedures), for the same eight procedures performed non-electively (urgent and emergent procedures), and for elective procedures and non-elective procedures combined (this third regression also controlled for procedure acuity). We present adjusted 30 day mortality by race and sex using marginal standardization, also known as predictive margins, by estimating predicted probabilities of 30 day mortality for each patient and averaging over the national sample.[27]

In the second set of analyses, to examine how any inequities in surgical mortality evolved over time, we used the same specification as in the first set of analyses (linear probability model of mortality for all eight surgical procedures as a function of race and sex, also controlling for age, Medicaid dual eligibility, disability, 27 chronic conditions, hospital service area fixed effects, weekend surgery, month fixed effects, year fixed effects, and procedure fixed effects) but replaced 30 day mortality rate with 7 day, 14 day, and 60 day mortality rate. Because inequities by race and sex were notable for elective procedures, this analysis focused on elective procedures; but in a sensitivity analysis we also repeated this analysis for elective and non-elective procedures combined (again controlling for procedure acuity when examining both types of produres combined).

In the third set of analyses, to examine whether differential distribution of patients across surgeons played a role in the inequities found, we compared the original results (linear probability model of 30 day mortality for all eight surgical procedures as a function of race and sex, also controlling for age, Medicaid dual eligibility, disability, 27 chronic conditions, hospital service area fixed effects, weekend surgery, month fixed effects, year fixed effects, and procedure fixed effects) when including hospital service area fixed effects with the results when replacing hospital service area fixed effects with surgeon fixed effects. The use of surgeon fixed effects effectively compares differences in 30 day mortality rate for patients of different subgroups of race and sex seen by the same surgeon. We used the change in coefficient on subgroup of race and sex from when including hospital service area fixed effects (which captures differences by race and sex both across and within physicians) to when including surgeon fixed effects (which is limited to differences by race and sex within physicians) as our measure of how differences in distribution of patients across surgeons has an influence on inequities in surgical mortality. Again, this analysis focused on elective procedures, but in a sensitivity analysis we also repeated this analysis for elective and non-elective procedures combined. For this analysis we focused on the difference in surgical mortality between Black and White men since subgroups of men had more comparable surgical mortality rates (on average higher surgical mortality

Table 1 | Characteristics of study sample of Medicare beneficiaries, 2016-18. Values are numbers (percentages) unless stated otherwise

Characterstics	All	Black men	White men	White women	Black women
Total No	1 868 036	40 479 (2.2)	761 076 (40.7)	998 166 (53.4)	68 315 (3.7)
Mean (SD) age (years)	75.4 (6.9)	73.7 (6.4)	75.2 (6.8)	75.7 (7.2)	74.3 (6.8)
Age category (years):					
65-69	494 575 (26.5)	14 283 (35.3)	201 277 (26.5)	256 186 (25.7)	22 829 (33.4)
70-74	507 463 (27.2)	11 240 (27.8)	213 359 (28.0)	264 542 (26.5)	18 322 (26.8)
75-79	402 534 (21.6)	7952 (19.6)	169 092 (22.2)	212 248 (21.3)	13 242 (19.4)
80-84	260 267 (13.9)	4452 (11.0)	105 629 (13.9)	142 119 (14.2)	8067 (11.8)
85-89	140 337 (7.5)	1908 (4.7)	52 548 (6.9)	81 903 (8.2)	3978 (5.8)
90-94	52 011 (2.8)	540 (1.3)	16 320 (2.1)	33 652 (3.4)	1499 (2.2)
95-99	10 849 (0.6)	104 (0.3)	2851 (0.4)	7516 (0.8)	378 (0.6)
Medicaid dual eligible	116 715 (6.3)	7150 (17.7)	30 871 (4.1)	64 303 (6.4)	14 391 (21.1)
Disability	197 350 (10.6)	9623 (23.8)	81 574 (10.7)	90 006 (9.0)	16 147 (23.6)
Comorbidities:					
Alzheimer's disease	69 359 (3.7)	1964 (4.9)	22 474 (3.0)	41 613 (4.2)	3308 (4.8)
Alzheimer's disease and related disorders	213 805 (11.5)	6283 (15.5)	76 161 (10.0)	121 472 (12.2)	9889 (14.5)
Acute myocardial infarction	104 615 (5.6)	3007 (7.4)	58 007 (7.6)	40 343 (4.0)	3258 (4.8)
Anemia	1 102 823 (59.0)	27 823 (68.7)	421 269 (55.4)	604 380 (60.6)	49 351 (72.2)
Asthma	279 850 (15.0)	5270 (13.0)	82 328 (10.8)	176 201 (17.7)	16 051 (23.5)
Atrial fibrillation	331 713 (17.8)	5709 (14.1)	167 972 (22.1)	150 926 (15.1)	7106 (10.4)
Breast cancer	118 711 (6.4)	100 (0.3)	1249 (0.2)	110 920 (11.1)	6442 (9.4)
Colorectal cancer	120 406 (6.5)	4123 (10.2)	53 154 (7.0)	58 132 (5.8)	4997 (7.3)
Endometrial cancer	22 013 (1.2)	1 (0.0)	10 (0.0)	20 881 (2.1)	1121 (1.6)
Lung cancer	57 776 (3.1)	1479 (3.7)	24 878 (3.3)	29 532 (3.0)	1887 (2.8)
Prostate cancer	116 849 (6.3)	8931 (22.1)	107 802 (14.2)	104 (0.0)	12 (0.0)
Cataract	1 249 838 (66.9)	19 398 (47.9)	473 966 (62.3)	714 209 (71.6)	42 265 (61.9)
Congestive heart failure	497 873 (26.7)	15 302 (37.8)	221 860 (29.2)	236 682 (23.7)	24 029 (35.2)
Chronic kidney disease	650 541 (34.8)	21 994 (54.3)	289 316 (38.0)	308 080 (30.9)	31 151 (45.6)
COPD	511 127 (27.4)	12 261 (30.3)	213 887 (28.1)	265 721 (26.6)	19 258 (28.2)
Depression	641 605 (34.4)	8989 (22.2)	184 912 (24.3)	424 788 (42.6)	22 916 (33.5)
Diabetes	670 612 (35.9)	22 181 (54.8)	294 301 (38.7)	316 697 (31.7)	37 433 (54.8)
Glaucoma	399 213 (21.4)	11 623 (28.7)	141 577 (18.6)	223 869 (22.4)	22 144 (32.4)
Hip/pelvic fracture	86 380 (4.6)	915 (2.3)	23 018 (3.0)	60 795 (6.1)	1652 (2.4)
Hyperlipidemia	1 531 204 (82.0)	31 895 (78.8)	634 449 (83.4)	808 478 (81.0)	56 382 (82.5)
Benign prostatic hyperplasia	388 001 (20.8)	19 300 (47.7)	368 429 (48.4)	242 (0.0)	30 (0.0)
Hypertension	1 590 470 (85.1)	37 471 (92.6)	656 984 (86.3)	831 353 (83.3)	64 662 (94.7)
Hypothyroidism	547 932 (29.3)	5166 (12.8)	138 885 (18.3)	386 207 (38.7)	17 674 (25.9)
Ischemic heart disease	991 560 (53.1)	24 190 (59.8)	480 944 (63.2)	450 522 (45.1)	35 904 (52.6)
Osteoporosis	376 893 (20.2)	1675 (4.1)	40 748 (5.4)	320 451 (32.1)	14 019 (20.5)
Rheumatoid arthritis/osteoarthritis	1 543 220 (82.6)	28 244 (69.8)	584 512 (76.8)	871 724 (87.3)	58 740 (86.0)
Stroke/transient ischemic attack	253 212 (13.6)	6958 (17.2)	104 068 (13.7)	130 749 (13.1)	11 437 (16.7)
Weekday surgery	1 762 969 (94.4)	37 929 (93.7)	719 763 (94.6)	940 379 (94.2)	64 898 (95.0)
Weekend surgery	105 067 (5.6)	2550 (6.3)	41 313 (5.4)	57 787 (5.8)	3417 (5.0)
Elective admission	1 313 002 (70.3)	23 652 (58.4)	527 992 (69.4)	714 842 (71.6)	46 516 (68.1)
Non-elective admission	555 034 (29.7)	16 827 (41.6)	233 084 (30.6)	283 324 (28.4)	21 799 (31.9)

COPD=chronic obstructive pulmonary disease; SD=standard deviation.

than women). Standard errors were clustered at the hospital service area level, except for the regression model that included surgeon fixed effects, for which standard errors were clustered at the surgeon level (see supplementary methods for further details).

Secondary analyses

We conducted a series of secondary analyses. To examine whether similar inequities are observed in Hispanic patients, we repeated our analyses including such patients. To test whether our findings were sensitive to our selection of the regression model, we repeated our analyses using a probit regression model instead of a linear probability model.[28 29] To evaluate the effect of adjustments for the socioeconomic status on our results, we repeated our analyses additionally adjusting for thirds of median household income (estimated from residential zip codes) and excluding the Medicaid dual eligibility from our adjustment variables.[30] To address the possibility that surgeon volume for a particular procedure is an important confounder, we repeated our analyses including thirds of procedure specific, hospital specific surgeon volumes (thirds of surgeon volume for a specific procedure at a specific hospital). Next, to test whether our results were sensitive to our selection of the geographic unit, we repeated our analyses including hospital fixed effects instead of hospital service area fixed effects. To account for the possibility that some surgeons could be performing surgery in multiple hospitals (and their performance may vary based on the hospital in which they practice), we repeated our analyses including fixed effects for unique combinations of surgeon and hospital instead of surgeon fixed effects. Furthermore, to address the possibility that some patients may travel a long distance (beyond hospital service area) to receive surgical care, we repeated our analyses using hospital referral region fixed effects instead of hospital service area fixed effects.[31] Then, to test whether our results were sensitive to how we accounted for the clustering of the data, we repeated our analyses using a hierarchical linear model (allowing random intercepts for each hospital service area) instead of using cluster robust standard errors. Finally, to test whether differential coding of procedure acuity influenced our results, we repeated our analyses excluding the procedure acuity (elective versus non-elective) from the adjustment variables.

All P values were from two sided tests and results were considered statistically significant at P<0.05. Analyses were performed using Stata, version 16.1 (StataCorp).

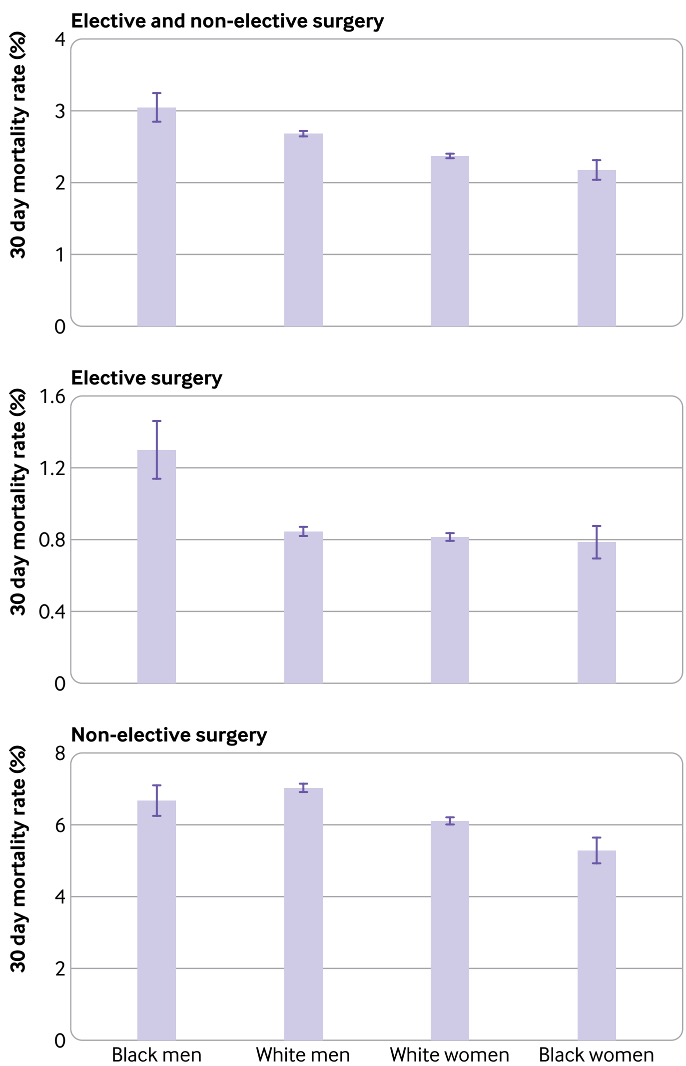

Fig 1 | 30 day mortality by surgical acuity (urgency of procedure) and by race and sex, among Medicare beneficiaries, 2016-18. Error bars represent 95% confidence intervals. Adjusted probabilities were calculated using marginal standardization from linear probability models of 30 day mortality for eight common surgical procedures (repair of abdominal aortic aneurysm, appendectomy, cholecystectomy, colectomy, coronary artery bypass surgery, hip replacement, knee replacement, and lung resection) as a function of category of race and sex (White men, White women, and Black women compared with Black men), also controlling for age, Medicaid dual eligibility, disability, 27 chronic conditions, surgical procedure, hospital service area, weekend surgery, month, and year. The regression model examining both non-elective and elective procedures also controlled for surgical acuity

Patient and public involvement

No patients or members of the public were involved in setting the research question or the outcome measures, nor were they involved in developing plans for the design or implementation of the study or asked to advise on interpretation or writing up of results. Although we support the importance of patient and public involvement, this was a secondary data analysis of existing claims data where the identifiers were not available for patients or members of the public for analysis, and as such it was not practical to involve them as members of this research study.

Results

The study population comprised 1 868 036 older patients (mean age 75.4 (standard deviation 6.9); 1 066 481 (57.1%) women) who underwent one of eight examined surgical procedures. Overall, 40 479 (2.2%) were Black men, 761 076 (40.7%) were White men, 998 166 (53.4%) were White women, and 68 315 (3.7%) were Black women (table 1). Overall, 105 067

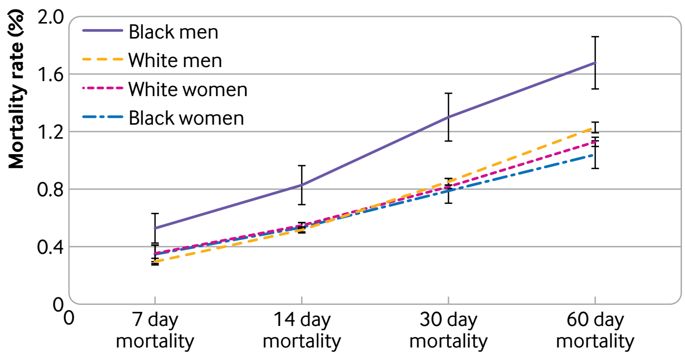

Fig 2 | Mortality rates after elective surgical procedures by number of postoperative days and by race and sex, among Medicare beneficiaries, 2016-18. Error bars represent 95% confidence intervals. Adjusted probabilities were calculated using marginal standardization from linear probability models of mortality for eight surgical procedures (repair of abdominal aortic aneurysm, appendectomy, cholecystectomy, colectomy, coronary artery bypass surgery, hip replacement, knee replacement, and lung resection) as a function of category of race and sex (White men, White women, and Black women compared with Black men), also controlling for age, Medicaid dual eligibility, disability, 27 chronic conditions, surgical procedure, hospital service area, weekend surgery, month, and year

(5.6%) patients had surgical procedures performed during weekends and 1 313 002 (70.3%) patients had elective procedures. Compared with Black men, White men and White women were less likely to be Medicaid dual eligible and less likely to enter Medicare because of disability, whereas Black women were more likely to be Medicaid dual eligible. White men, White women, and Black women were more likely to be admitted for elective surgery compared with Black men.

Surgical mortality by race and sex

After adjusting for potential confounders, Black men experienced a higher overall mortality (1698 deaths, adjusted mortality rate 3.05%, 95% confidence interval 2.85% to 3.24%) compared with White men (21 833 deaths, 2.69%, 2.65% to 2.73%), White women (21 847 deaths, 2.38%, 2.35% to 2.41%), and Black women (1631 deaths, 2.18%, 2.04% to 2.31%) (fig 1). A similar pattern was found for the eight procedures performed electively, with a higher mortality in Black men (393 deaths, 1.30%, 1.14% to 1.46%) compared with White men (5650 deaths, 0.85%, 0.83% to 0.88%), White women (4615 deaths, 0.82%, 0.80% to 0.84%), and Black women (359 deaths, 0.79%, 0.70% to 0.88%) (fig 1). This 0.45 percentage point difference implies that mortality after elective procedures was 50% higher in Black men compared with White men (adjusted mortality rates 1.30% *v* 0.85%, respectively). For these same procedures performed non-electively we did not find a statistically significant difference in mortality between Black men and White men (1305 deaths, 6.69%, 6.26% to 7.11%; and 16 183 deaths, 7.03%, 6.92% to 7.14%, respectively), but we found a lower mortality for White women and Black women (17 232 deaths, 6.12%, 6.02% to 6.21%; and 1272 deaths, 5.29%, 4.93% to 5.64%, respectively) (fig 1). Supplementary table B shows the results for individual procedures.

Surgical mortality over time

When examining how inequities in mortality by race and sex for elective surgical procedures evolved over time, in adjusted analyses the difference in mortality after an elective procedure between Black men and White men was apparent within seven days of surgery (0.30% (95% confidence interval 0.28% to 0.32%) for White men and 0.53% (0.43% to 0.64%) for Black men; difference of 0.23 percentage points (95% confidence interval 0.12 to 0.34)) and persisted for at least 60 days after surgery (1.23% (1.20% to 1.27%) for White men and 1.68% (1.49% to 1.86%) for Black men; difference of 0.44 percentage points (0.25 to 0.63)) (fig 2 and supplementary table C). Results were broadly similar when elective and non-elective surgical procedures were examined together (see supplementary figure A and supplementary table D).

Surgical mortality differences accounting for distribution of patients

When we accounted for the differential distribution of patients across surgeons, the difference in 30 day elective surgical mortality between Black men and White men decreased from 0.44 percentage points (95% confidence interval 0.28 to 0.61) to 0.31 percentage points (0.14 to 0.48) when comparing patients seen by the same surgeon. This translates to 31.3% of the difference between Black men and White men in elective surgical mortality attributable to differences in distribution of these patients across surgeons, but leaving two thirds of the difference attributable to other factors. Results were similar when elective and non-elective surgical procedures were examined together (see supplementary table E), with 35.2% of the difference in overall surgical mortality between Black men and White men attributable to differences in distribution of these patients across surgeons.

Secondary analyses

Hispanic men and Hispanic women showed a lower overall mortality (2.49% (95% confidence interval 2.29% to 2.69%) for Hispanic men and 2.38% (2.22% to 2.55%) for Hispanic women versus 3.06% (2.86% to 3.25%) for Black men) and a lower mortality after elective surgical procedures (0.92% (0.76% to 1.09%) for Hispanic men and 0.87% (0.75% to 0.98%) for Hispanic women versus 1.30% (1.14% to 1.47%) for Black men) (see supplementary table F). Findings in all our sensitivity analyses remained qualitatively unchanged (see supplementary tables G-O).

Discussion

Among a nationally representative sample of older Medicare beneficiaries, postoperative mortality overall was higher in Black men compared with White men, White women, and Black women, which was largely attributable to a 50% higher mortality in Black men than White men undergoing elective procedures. This difference was noticeable within seven days of surgery and persisted for at least 60 days. We also found that the differential distribution of patients across surgeons accounted for about one third of the difference in elective surgical mortality between Black men and White men, with the remainder of the difference persisting even when patients operated on by the same surgeon were compared. These findings highlight the need to understand better the unique challenges Black men who require surgery face in the US.

Policy implications

Structural racism—the impact of racial discrimination across systems in society (including healthcare) that creates inequities in resources and in environments—may, at least partially, explain our findings. For example, Black patients living in neighborhoods with predominantly Black residents tend to live close to hospitals that lack resources to provide high quality healthcare.[32 33] As a result, Black patients may lack access to specialists (including surgeons) with advanced clinical training and to important clinical resources, such as advanced diagnostic imaging studies and tests.[34] This could lead to delays in care resulting in more advanced disease that requires longer or more difficult operations and might explain our finding of an increased mortality with elective procedures.[35 36] Poorer preoperative optimization of comorbidities such as diabetes and hypertension among racially minoritized patients may also lead to inequities in surgical outcomes. Similarly, Black individuals are more likely to live in areas with greater exposure to hazards such as air pollution, which might increase the prevalence and severity of chronic diseases.[37 38] These differences in neighborhood and home environments and in resources could make it more challenging for Black patients to recover at home and to attend postoperative clinical visits.[39] Our finding that surgical mortality is higher among Black men compared with other subgroups of race and sex is consistent with the finding that Black men have substantially shorter life expectancy at birth compared with other subgroups.[40] Even for comparisons within races, Black men show a higher burden of homicide and HIV than Black women.[40] In addition, it is possible that Black men in particular may face especially high cumulative amounts of stress and allostatic load in the US, potentially contributing to accelerated declines in physical health status[41-44] and leading to a higher mortality after surgical procedures.

Other factors may interact with structural racism to worsen surgical outcomes. Physicians might perceive that Black patients are less likely to adhere to medical advice, which can contribute to differences in recommendations for surgery.[45] This could exacerbate delays in care. In addition, Black patients, due to mistreatment, may have developed a distrust about healthcare providers that further contributes to poorly controlled chronic disease.[40] Differences in referral patterns by race might be another factor—a recent study, for example, found that specialty networks (including for surgery) were smaller for Black patients.[46] These differences in networks could potentially mean that Black patients see lower quality surgeons. In addition, we found that inequities in mortality appeared within seven days of surgery and persisted for at least 60 days, suggesting differences in management by race in the early postoperative period.[10] For example, timely recognition and management of complications early in the postoperative period might differ for Black patients.[47] The extensive literature on inequities in pain management by race may provide insight, as pain reported by Black patients is less recognized and undertreated compared with White patients.[48] Better standardization of care (such as through enhanced recovery after surgery programs) may help mitigate some of these factors and reduce inequities in surgical outcomes.[49]

Comparison with other studies

Evidence from other countries that have examined racial inequities in surgical access and outcomes is limited to studies on individual surgical procedures with relatively small sample size. For example, a study of vascular bypass procedures in England found no differences in mortality by race but higher rates of limb loss among Black patients.[50] Another study from England and from Wales found that mortality was higher among Black infants undergoing cardiac surgery than among White infants; however, this difference did not reach statistical significance, possibly owing to the small sample size (only 240 Black infants were included in the sample).[51] Our study sample comprised more than 100 000 Black patients, which enabled us to detect clinically meaningful differences in surgical mortality by race and sex. Given that racial inequities may vary due to differences in geographic and historic context (eg, magnitude of structural racism), further studies are warranted to understand whether similar findings are observed in other countries.

Stengths and limitations of this study

This study has several limitations. We focused on Black patients and White patients (and Hispanic patients in a sensitivity analysis), but we did not examine people of other races, including individuals who were of multiple races. As our study was observational, residual confounding is possible. Results were limited to the Medicare fee-for-service population and might not be generalizable to other populations, including younger patients and those with Medicare Advantage. Our use of inpatient data precludes the inclusion of surgical procedures performed at other sites, including ambulatory surgery centers. Results are based on claims data, and more specific details about patient risk during the surgical procedure were not included. We are unable to account for the potential racial and sex differences in patients' choice of care, although preference for less or different treatment may reflect distrust related to past discrimination.[30] Because of the lack of data, we could not adjust for lifestyle factors such as body mass index and smoking. However, given that processed food, a contributory factor in obesity, and tobacco are more readily available in racially minoritized communities than regions with predominantly White residents,[52 53] these variables can be seen as factors in the causal pathway linking race and sex with surgical mortality and thus should not be adjusted for in analyses. Our outcomes were limited to mortality associated with eight surgical procedures and therefore may not be generalizable to other surgical procedures or to other outcomes, such as complication rates and patient experience.

Conclusions

Among a national sample of Medicare beneficiaries undergoing one of eight common surgical procedures, we found that Black men experience higher mortality after elective procedures than other subgroups of race and sex, but not after non-elective procedures. Further research is needed to understand better the preoperative, intraoperative, and postoperative factors contributing to this higher mortality rate among Black men after elective surgery.

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Ethical approval: Not required as the University of California, Los Angeles independent review board determined that this was not human subjects research.

Data sharing: The Medicare data cannot be shared.

The guarantor (YT) affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Dissemination to participants and related patient and public communities: Our research findings will be disseminated through press releases, interviews with local and national media, social media posts on Twitter, and academic conferences.

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Supplementary information: Additional methods, and tables A-O