Original Article

Recent racial/ethnic disparities in cancer-specific mortality among patients diagnosed with rectal cancer

Lu Li[1,2], Zhenpeng Xu[1,3], Guanghua Chen[2], Leichang Zhang[2], Zhihua Lu[1], Chen Chen[1], Yugen Chen[1]

[1]Department of Colorectal Surgery, Jiangsu Province Hospital of Chinese Medicine, The Affiliated Hospital of Nanjing University of Chinese Medicine, Nanjing, China; [2]Department of Colorectal Surgery, The Affiliated Hospital of Jiangxi University of Chinese Medicine, Nanchang, China; [3]Department of Colorectal Surgery, People's Hospital Affiliated to Fujian University of Traditional Chinese Medicine, Fuzhou, China

Contributions: (I) Conception and design: L Li, Z Xu; (II) Administrative support: Y Chen; (III) Provision of study materials or patients: Z Xu, C Chen; (IV) Collection and assembly of data: L Zhang, Z Lu; (V) Data analysis and interpretation: L Li, Z Xu, G Chen; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Yugen Chen, MD. Department of Colorectal Surgery, Jiangsu Province Hospital of Chinese Medicine, The Affiliated Hospital of Nanjing University of Chinese Medicine, 155 Hanzhong Rd., Qin Huai Qu, Nanjing 210029, China. Email: yugen.chen@njucm.edu.cn.

Background: African American patients frequently receive nonstandard treatment and demonstrate poorer overall survival (OS) outcomes compared to White patients. Our objective was to analysis whether racial/ethnic disparities in rectal cancer-specific mortality remain after accounting for clinical characteristics, treatment, and access-to-care-related factors.

Methods: Individuals diagnosed with rectal cancer between 2011 and 2020 were identified using the Surveillance, Epidemiology, and End Results Database. The cumulative incidence of rectal cancer-specific mortality was computed. Sub-distribution hazard ratios (sdHRs) and 95% confidence intervals (CIs) for rectal cancer-specific mortality associated with race/ethnicity were estimated using Fine and Gray model with stepwise adjustments for clinical characteristics, treatment modalities, and factors related to access-to-care.

Results: Among 54,370 patients, non-Hispanic (NH) Black individuals exhibited the highest cumulative incidence of rectal cancer-specific mortality (39%), followed by American Indian/Alaska Native (AI/AN) (35%), Hispanics (32%), NH-White (31%), and Asian/Pacific Islander (API) (30%). After adjusting for clinical characteristics, NH-Black patients had a 28% increased risk of rectal cancer mortality (sdHR, 1.28; 95% CI: 1.20–1.35) compared to NH-White patients. In contrast, mortality disparities between Hispanic-White, AI/AN-White, and API-White groups were not significant. The Black-White mortality differences persisted even after adjustments for treatment and access-to-care-related factors. In stratified analyses, among patients with a median household income below $59,999, AI/AN patients showed higher mortality than NH-Whites when adjusted for clinical characteristics (sdHR, 1.32; 95% CI: 1.03–1.70).

Conclusions: Overall, the racial/ethnic disparities in rectal cancer-specific mortality were largely attributable to differences in clinical characteristics, treatment modalities, and factors related to access-to-care. These findings emphasize the critical need for equitable healthcare to effectively address and reduce the significant racial/ethnic disparities in rectal cancer outcomes.

Keywords: Rectal cancer; racial/ethnic disparities; cancer-specific mortality; The United States

Received: 01 December 2023; Accepted: 18 April 2024; Published online: 13 June 2024.

doi: 10.21037/tgh-24-1

View this article at: https://dx.doi.org/10.21037/tgh-24-1

Introduction

In 2023, an estimated 46,050 American men and women were diagnosed with rectal cancer (1). Advances in early diagnosis and comprehensive treatment have significantly enhanced the overall survival (OS) for patients with rectal cancer (2,3). However, this progress in prognosis is not uniformly experienced across all population groups. Particularly, individuals from racial and ethnic minority communities often face nonstandard treatments and a subsequent decline in quality of life following their cancer diagnosis (4-6). Consequently, racial and ethnic disparities continue to be a pressing issue, influencing the outcomes of rectal cancer survivors (7,8).

Data regarding disparities in racial and ethnic outcomes for rectal cancer are notably scarce. Investigations using the National Cancer Database reveal that African American patients often receive nonstandard treatment and exhibit poorer OS outcomes in comparison to White patients (5,9). Notably, these findings are restricted to cases of locally advanced rectal cancer. Furthermore, a comprehensive meta-analysis highlighted those factors such as African American race, lower educational attainment, government insurance, and undergoing surgery in nonacademic or low-volume hospitals correlate with reduced OS following rectal cancer surgery (4). These studies predominantly concentrate on disparities between African American and White populations, often overlooking other racial and ethnic groups like Hispanic, Asian and Pacific Islander (API), and American Indian or Alaska Native (AI/AN) communities. Nevertheless, comprehending the trends and patterns among rectal cancer patients of diverse races and ethnicities is vital to promote health equity. To date, there is an absence of research documenting trends in racial and ethnic disparities of cancer-specific mortality among White, Hispanic, API, and AI/AN rectal cancer patient. In addition, the majority of existing studies predominantly focus on OS, ignoring competing risks of death. As survival rates improve, rectal cancer survivors face an increased risk of mortality from causes other than rectal cancer.

To tackle these significant knowledge gaps, this study utilizes data from the Surveillance, Epidemiology, and End Results (SEER) Program to conduct a thorough analysis of how race and ethnicity affect mortality rates in rectal cancer. This data will yield valuable insights into customized strategies aimed at reducing these disparities and enhancing treatment outcomes for all patients with rectal cancer. We present this article in accordance with the STROBE reporting checklist (available at https://tgh.amegroups.com/article/view/10.21037/tgh-24-1/rc).

Highlight box

Key findings

- Non-Hispanic (NH)-Black patients exhibited the highest cumulative incidence of rectal cancer-specific mortality at 39%, followed by American Indian or Alaska Native (AI/AN) patients at 35%, Hispanic patients at 32%, and NH-White patients at 31%.
- NH-Black patients experience a 28% higher rectal cancer-specific mortality [sub-distribution hazard ratios (sdHRs), 1.28; 95% confidence intervals (CIs), 1.20–1.35] compared to their NH-White counterparts after adjusting for clinical characteristics.
- Among patients with a low median household income (<$59,999), AI/AN patients demonstrated higher mortality compared to NH-White when adjusted for clinical characteristics (sdHR, 1.32, 95% CI: 1.03–1.70).

What is known and what is new?

- African American patients often receive nonstandard treatment and exhibit poorer overall survival outcomes in comparison to White patients.
- We assessed racial/ethnic disparities in rectal cancer-specific mortality remain after accounting for clinical characteristics, treatment, and access-to-care-related factors.

What is the implication, and what should change now?

- These findings emphasize the critical need for equitable healthcare to effectively address and reduce the significant racial/ethnic disparities in rectal cancer outcomes.

Methods

Study design and data sources

Data was extracted from the SEER Program using the SEER*Stat software version 8.4.2. The selection encompassed SEER 17 registries, spanning roughly 26.5% of the overall US population. All eligible individuals diagnosed with rectal cancer (International Classification of Diseases for Oncology, 3rd Edition ICD-O-3 histological code: 8140–8147, 8210–8213, 8255, 8260-8263, 8480, 8481, 8490) between 2011 and 2020 were tracked until either their death or until the data reporting concluded on December 31, 2022, within the SEER program. Due to the anonymous processing of data within the SEER database, institutional review board approval was unnecessary. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

Information regarding clinical attributes, treatment

modalities, and factors influencing access-to-care was gathered from the SEER database. Clinical characteristics, sourced from the SEER, encompassed race/ethnicity, gender, age at diagnosis, tumor grade, and stage. It is imperative to note that, as per the United States Census Bureau, race and Hispanic origin (ethnicity) are distinct categories. Individuals of Hispanic background can be affiliated with any race, and within each racial category, individuals may identify as either Hispanic or Non-Hispanic (NH). For our primary exposure variable, we classified race/ethnicity into five mutually exclusive groups utilizing the SEER's original coding standards: NH-White, NH-Black, NH-API, NH-AI/AN, and Hispanic. The available data on treatment receipt encompassed surgery, chemotherapy, and radiotherapy. Notably, detailed chemotherapy regimens were not documented in the SEER, leading to their classification as either "yes" or "no/unknown" in this study. Factor associated with access-to-care was defined by median household income.

Outcomes

Patient follow-up commenced at the time of cancer diagnosis and continued until either the patient's death or the censoring date of December 31, 2022, depending on which occurred first. The causes of death were classified in accordance with the International Classification of Diseases, Tenth Revision (ICD-10). The primary outcome was rectal cancer-specific mortality, calculated as the duration in months from the date of cancer diagnosis to the date of death due to rectal cancer.

Statistical analysis

Descriptive characteristics across various racial/ethnic groups were analyzed using the Chi-Square (χ^2) test for categorical variables and Analysis of Variance (ANOVA) for continuous variables. The cumulative incidence of rectal cancer-specific mortality at 1, 3, and 5 years of follow-up was computed using the Fine and Gray model (10). This analysis was conducted both holistically and stratified by gender and median household income, providing a comprehensive overview of the incidence patterns.

Multivariable Fine-Gray models were employed to estimate subdistribution hazard ratios (sdHRs) and 95% confidence intervals (CIs) for the associations between racial/ethnic groups and rectal cancer-specific mortality (11). These sdHRs and 95% CIs were calculated through a three-tiered adjustment process: (I) adjusting for clinical characteristics; (II) further adjusting for treatment modalities; and (III) additional adjustment for factors related to access-to-care, as previously defined. In cause-specific models, the follow-up was censored when a competing cause of death occurred. The Fine-Gray model assesses covariate effects on the likelihood of an event in the presence of competing risks by utilizing the subdistribution hazard function. It calculates the immediate risk of an event, assuming proportional hazards across groups, and sums up effects with hazard ratios (12). The Fine-Gray model takes into account the impact of other causes of death on the likelihood of experiencing the event of interest (13,14). Stratified analyses by gender, median household income, and age were also conducted.

All statistical tests were two-sided, with significance thresholds set at $P<0.05$, and were conducted without adjustments for multiple comparisons. These analyses were performed using R version 4.3.0 (R Foundation).

Results

A total of 54,370 patients with rectal cancer were identified who met inclusion criteria. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The distribution across different racial and ethnic groups was as follows: 35,481 (65.3%) were identified as NH-White, 4,608 (8.5%) as NH-Black, 8,047 (14.8%) as Hispanic, 535 (1.0%) as AI/AN, and 5,699 (10.5%) as API patients.

Compared to NH-White patients, NH-Black, Hispanic, AI/AN, and API patients were more likely to be diagnosed before the age of 55. While approximately 70% of all patients in the study underwent surgery, this treatment was reported more frequently among NH-White and API patients than their NH-Black counterparts. The highest proportion of patients with a median household income below $59,999 was observed among NH-Black patients (42.6%), followed by AI/AN patients (36.1%). Out of the entire study cohort, 19,651 individuals (36.1%) passed away during the study period. This included 15,032 (27.6%) who died from rectal cancer itself, and 4,619 (8.5%) whose deaths were due to causes other than rectal cancer (*Table 1*).

Overall, at 5-year post-diagnosis, NH-Black patients exhibited the highest cumulative incidence of rectal cancer-specific mortality at 39%, followed by AI/AN patients at 35%, Hispanic patients at 32%, and NH-White patients at 31% (P=0.04). In contrast, API patients had the lowest mortality rate, standing at 30% (*Table 2* and *Figure 1*). These trends were consistent among both male and female patients. Within the group of patients with a low

Table 1 Characteristics of the study population

Characteristics	Overall (N=54,370)	White (N=35,481)	Black (N=4,608)	Hispanic (N=8,047)	AI/AN (N=535)	API (N=5,699)	P
Gender							<0.001
Male	33,175 (61.0)	21,549 (60.7)	2,749 (59.7)	5,064 (62.9)	308 (57.6)	3,505 (61.5)	
Female	21,195 (39.0)	13,932 (39.3)	1,859 (40.3)	2,983 (37.1)	227 (42.4)	2,194 (38.5)	
Age at diagnosis (years)							<0.001
<55	16,430 (30.2)	9,897 (27.9)	1,486 (32.2)	3,062 (38.1)	179 (33.5)	1,806 (31.7)	
55–64	15,683 (28.8)	10,170 (28.7)	1,425 (30.9)	2,319 (28.8)	155 (29.0)	1,614 (28.3)	
65–74	12,550 (23.1)	8,556 (24.1)	1,018 (22.1)	1,595 (19.8)	126 (23.6)	1,255 (22.0)	
75+	9,707 (17.9)	6,858 (19.3)	679 (14.7)	1,071 (13.3)	75 (14.0)	1,024 (18.0)	
Tumor grade							<0.001
Well	3,642 (6.7)	2,320 (6.5)	274 (5.9)	656 (8.2)	47 (8.8)	345 (6.1)	
Moderate	27,668 (50.9)	18,414 (51.9)	2,235 (48.5)	3,837 (47.7)	257 (48.0)	2,925 (51.3)	
Poorly	3,909 (7.2)	2,503 (7.1)	345 (7.5)	575 (7.1)	33 (6.2)	453 (7.9)	
Undifferentiated	451 (0.8)	331 (0.9)	40 (0.9)	43 (0.5)	4 (0.7)	33 (0.6)	
Unknown	18,700 (34.4)	11,913 (33.6)	1,714 (37.2)	2,936 (36.5)	194 (36.3)	1,943 (34.1)	
Stage							<0.001
Distant	11,093 (20.4)	7,098 (20.0)	1,107 (24.0)	1,682 (20.9)	137 (25.6)	1,069 (18.8)	
Localised/regional	40,875 (75.2)	26,962 (76.0)	3,290 (71.4)	5,927 (73.7)	378 (70.7)	4,318 (75.8)	
Unknown	2,402 (4.4)	1421 (4.0)	211 (4.6)	438 (5.4)	20 (3.7)	312 (5.5)	
Surgery							<0.001
Yes	37,773 (69.5)	25,067 (70.6)	2,934 (63.7)	5,358 (66.6)	354 (66.2)	4,060 (71.2)	
No	15,240 (28.0)	9,587 (27.0)	1,535 (33.3)	2,445 (30.4)	169 (31.6)	1,504 (26.4)	
Unknown	1,357 (2.5)	827 (2.3)	139 (3.0)	244 (3.0)	12 (2.2)	135 (2.4)	
Chemotherapy							<0.001
Yes	18,704 (34.4)	12,350 (34.8)	1,564 (33.9)	2,570 (31.9)	174 (32.5)	2,046 (35.9)	
No/unknown	35,666 (65.6)	23,131 (65.2)	3,044 (66.1)	5,477 (68.1)	361 (67.5)	3,653 (64.1)	
Radiotherapy							0.02
Yes	30,471 (56.0)	19,786 (55.8)	2,564 (55.6)	4,624 (57.5)	321 (60.0)	3,176 (55.7)	
No/unknown	23,899 (44.0)	15,695 (44.2)	2,044 (44.4)	3,423 (42.5)	214 (40.0)	2,523 (44.3)	
Median household income							<0.001
<$59,999	14,574 (26.8)	10,702 (30.2)	1,961 (42.6)	1,402 (17.4)	193 (36.1)	316 (5.5)	
$60,000–$74,999	17,837 (32.8)	10,966 (30.9)	1,531 (33.2)	3,521 (43.8)	107 (20.0)	1,712 (30.0)	
$75,000+	21,956 (40.4)	13,812 (38.9)	1,116 (24.2)	3,122 (38.8)	235 (43.9)	3,671 (64.4)	
Unknown	3 (0.0)	1 (0.0)	0 (0.0)	2 (0.0)	0 (0.0)	0 (0.0)	
Vital status							
Alive	34,719 (63.9)	22,557 (63.6)	2,556 (55.5)	5,394 (67.0)	323 (60.4)	3,889 (68.2)	
Dead from rectal cancer	15,032 (27.6)	9,759 (27.5)	1,580 (34.3)	2,094 (26.0)	166 (31.0)	1,433 (25.1)	
Dead from causes other than rectal cancer	4,619 (8.5)	3,165 (8.9)	472 (10.2)	559 (6.9)	46 (8.6)	377 (6.6)	

Data are presented as n (%). API, Asian or Pacific Islander; AI/AN, American Indian/Alaska Native.

Table 2 Cumulative incidence of rectal cancer specific mortality by race/ethnicity

Characteristics	1-year		3-year		5-year	
	Cumulative incidence	95% CI	Cumulative incidence	95% CI	Cumulative incidence	95% CI
Overall population						
White	0.11	(0.09–0.13)	0.24	(0.22–0.26)	0.31	(0.24–0.38)
Black	0.14	(0.10–0.18)	0.31	(0.27–0.35)	0.39	(0.32–0.46)
Hispanic	0.10	(0.08–0.12)	0.24	(0.19–0.29)	0.32	(0.27–0.37)
AI/AN	0.14	(0.13–0.15)	0.27	(0.20–0.34)	0.35	(0.28–0.42)
API	0.09	(0.05–0.13)	0.23	(0.21–0.25)	0.30	(0.23–0.37)
Male						
White	0.10	(0.08–0.12)	0.24	(0.17–0.31)	0.31	(0.21–0.41)
Black	0.15	(0.14–0.16)	0.33	(0.25–0.41)	0.42	(0.25–0.59)
Hispanic	0.10	(0.07–0.13)	0.25	(0.22–0.28)	0.33	(0.25–0.41)
AI/AN	0.14	(0.13–0.15)	0.29	(0.19–0.39)	0.38	(0.28–0.48)
API	0.09	(0.08–0.10)	0.23	(0.19–0.27)	0.30	(0.16–0.44)
Female						
White	0.12	(0.10–0.14)	0.24	(0.20–0.28)	0.31	(0.22–0.40)
Black	0.12	(0.10–0.14)	0.28	(0.23–0.33)	0.35	(0.23–0.47)
Hispanic	0.09	(0.08–0.10)	0.22	(0.18–0.26)	0.30	(0.23–0.37)
AI/AN	0.15	(0.14–0.16)	0.24	(0.18–0.30)	0.32	(0.17–0.47)
API	0.10	(0.06–0.14)	0.23	(0.19–0.27)	0.31	(0.22–0.40)
Median household income						
<$59,999						
White	0.12	(0.08–0.16)	0.25	(0.21–0.29)	0.33	(0.22–0.44)
Black	0.14	(0.13–0.15)	0.32	(0.22–0.42)	0.41	(0.31–0.51)
Hispanic	0.11	(0.10–0.12)	0.24	(0.14–0.34)	0.34	(0.24–0.44)
AI/AN	0.16	(0.12–0.20)	0.32	(0.28–0.36)	0.41	(0.30–0.52)
API	0.11	(0.08–0.14)	0.30	(0.26–0.34)	0.37	(0.25–0.49)
$60,000–$74,999						
White	0.11	(0.10–0.12)	0.24	(0.14–0.34)	0.31	(0.18–0.44)
Black	0.13	(0.11–0.15)	0.30	(0.18–0.42)	0.38	(0.26–0.50)
Hispanic	0.10	(0.08–0.12)	0.24	(0.22–0.26)	0.33	(0.25–0.41)
AI/AN	0.17	(0.15–0.19)	0.28	(0.22–0.34)	0.40	(0.28–0.52)
API	0.11	(0.09–0.13)	0.26	(0.21–0.31)	0.33	(0.22–0.44)
$75,000+						
White	0.10	(0.07–0.13)	0.23	(0.21–0.25)	0.29	(0.23–0.35)
Black	0.13	(0.12–0.14)	0.31	(0.25–0.37)	0.39	(0.29–0.49)
Hispanic	0.09	(0.05–0.13)	0.23	(0.15–0.31)	0.30	(0.25–0.35)
AI/AN	0.11	(0.05–0.17)	0.22	(0.14–0.30)	0.28	(0.19–0.37)
API	0.08	(0.05–0.11)	0.21	(0.17–0.25)	0.28	(0.24–0.32)

API, Asian or Pacific Islander; AI/AN, American Indian/Alaska Native; CI, confidence interval.

median household income (<$59,999), NH-Black and AI/AN patients demonstrated similar higher mortality rates, reaching 41%, while NH-White patients had the lowest mortality rates (P=0.04). Among patients with a median household income between $60,000 and $74,999, AI/AN patients exhibited the highest mortality rate at 40%, while NH-White patients had the lowest mortality rate at 31% (P=0.02). For patients with a high median household income ($75,000+), NH-Black patients had the highest mortality rate at 39%, while other racial and ethnic groups displayed similar mortality rates (P=0.04) (*Table 2*).

Racial and ethnic disparities in rectal cancer-specific mortality persist after adjusting for clinical characteristics.

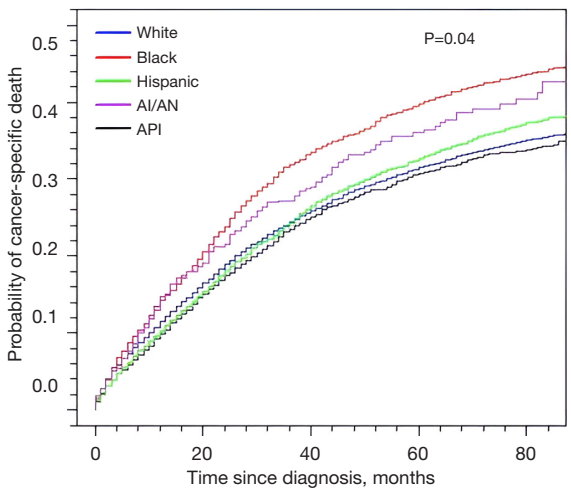

Figure 1 Cumulative incidence of rectal cancer-specific mortality by race/ethnicity. AI/AN, American Indian or Alaska Native; API, Asian and Pacific Islander.

NH-Black patients experience a 28% higher rectal cancer-specific mortality (sdHR, 1.28; 95% CI: 1.20–1.35) compared to their NH-White counterparts. In contrast, the disparities in mortality between Hispanic-White (sdHR, 1.03; 95% CI: 0.99–1.09), AI/AN-White (sdHR, 1.14; 95% CI: 0.97–1.34), and API-White (sdHR, 0.96; 95% CI: 0.91–1.01) are not significant. Additional adjustment for treatment and further adjustment for factors related to access-to-care, slightly reduce the disparity in point estimates for racial and ethnic minorities compared to NH-White patients (*Table 3*).

The patterns of association observed were generally consistent across genders, with one notable exception: female NH-Black patients (sdHR, 1.01, 95% CI: 0.92–1.12) exhibited a similar risk of rectal cancer-specific mortality as their female NH-White counterparts after full adjustments (*Figure 2*). Among patients with a low median household income (<$59,999), AI/AN patients demonstrated higher mortality compared to NH-White when adjusted for clinical characteristics (sdHR, 1.32, 95% CI: 1.03–1.70) . However, this disparity was not observed after fully adjustments (sdHR, 1.20, 95% CI: 0.92–1.57) (*Figure 3*). The age-stratified analysis found that the disparity vanished in patients aged over 75 (sdHR, 1.04, 95% CI: 0.92–1.17) (*Figure 4*).

Discussion

In this nationwide registry-based study, we observed that NH-Black patients with rectal cancer experience higher rectal cancer-specific mortality compared to their NH-White counterparts, even after adjustment for clinical

Table 3 sdHRs (95% CI) for rectal cancer-specific mortality associated with race/ethnicity among patients with rectal cancer

Race/ethnicity	sdHR (95% CI)		
	Model 1	Model 2	Model 3
White	1.00 (reference)	1.00 (reference)	1.00 (reference)
Black	1.28 (1.20–1.35)	1.18 (1.12–1.25)	1.15 (1.08–1.21)
Hispanic	1.03 (0.99–1.09)	0.98 (0.94–1.03)	1.00 (0.95–1.05)
AI/AN	1.14 (0.97–1.34)	1.04 (0.88–1.23)	1.05 (0.88–1.24)
API	0.96 (0.91–1.01)	0.95 (0.89–1.01)	1.00 (0.94–1.06)

Model 1, adjusted for clinical characteristics (gender, age at diagnosis, tumor grade and stage); Model 2, additionally adjusted for treatment (surgery, radiotherapy and chemotherapy); Model 3, additionally adjusted for factors related to access-to-care (median household income). sdHR, sub-distribution hazard ratio; CI, confidence interval; AI/AN, American Indian/Alaska Native; API, Asian or Pacific Islander.

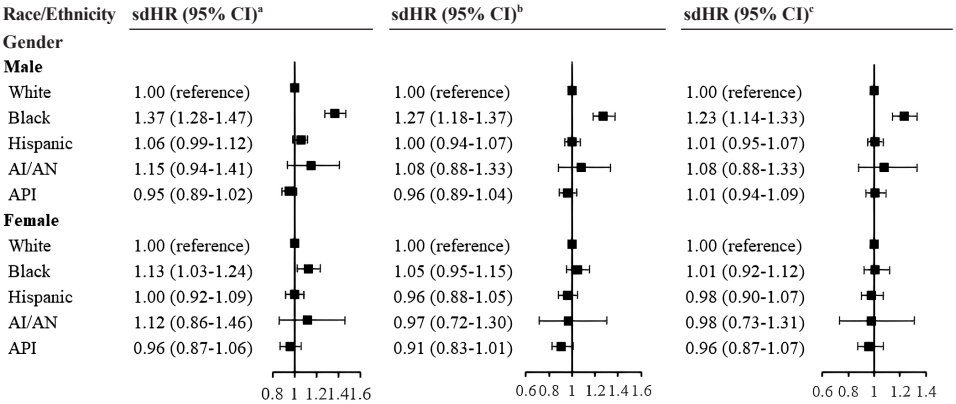

Figure 2 Multivariable-adjusted sdHRs (95% CI) for cancer-specific mortality in rectal cancer associated with race/ethnicity by gender. The sdHRs and 95% CIs derived from: [a], Model 1, adjusted for clinical characteristics (age at diagnosis, tumor grade and stage); [b], Model 2, additionally adjusted for treatment (surgery, radiotherapy and chemotherapy); [c], Model 3, additionally adjusted for factors related to access-to-care (median household income). HR, hazard ratio; CI, confidence interval; AI/AN, American Indian or Alaska Native; API, Asian and Pacific Islander; sdHRs, sub-distribution hazard ratios.

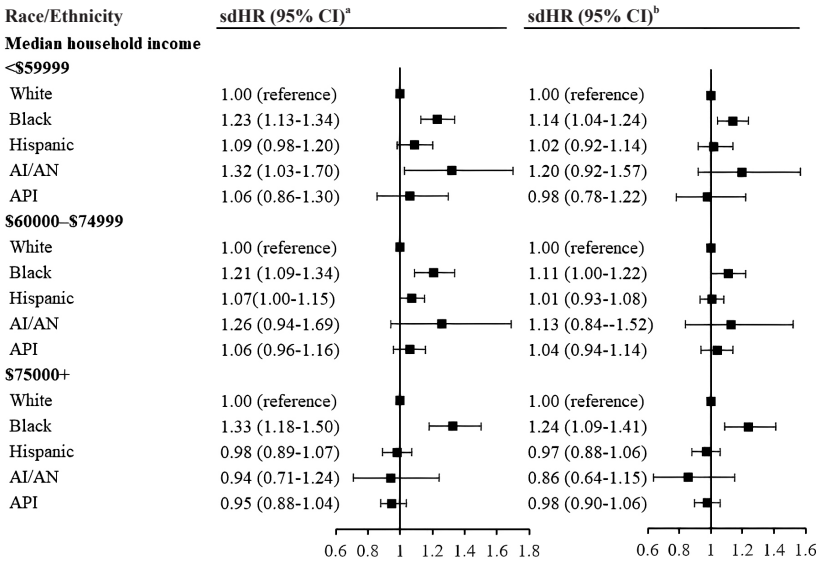

Figure 3 Multivariable-adjusted sdHRs (95% CI) for cancer-specific mortality in rectal cancer associated with race/ethnicity by median household income. The sdHRs and 95% CIs derived from: [a], Model 1, adjusted for clinical characteristics (gender, age at diagnosis, tumor grade and stage); [b], Model 2, additionally adjusted for treatment (surgery, radiotherapy and chemotherapy). HR, hazard ratio; CI, confidence interval; AI/AN, American Indian or Alaska Native; API, Asian and Pacific Islander; sdHRs, sub-distribution hazard ratios.

characteristics. This association persisted despite thorough adjustments. Nonetheless, the mortality disparities between Hispanic-White, AI/AN-White, and API-White groups were not statistically significant, except in lower-income patients (median household income <$59,999), where AI/AN patients exhibited poorer outcomes when adjusted for clinical characteristics. In addition, Black patients had the highest 5-year cumulative incidence of rectal cancer-specific mortality among the five racial/ethnic groups, whereas API patients had the lowest.

Racial/ethnic mortality disparities following rectal cancer diagnosis have not been sufficiently explored, and

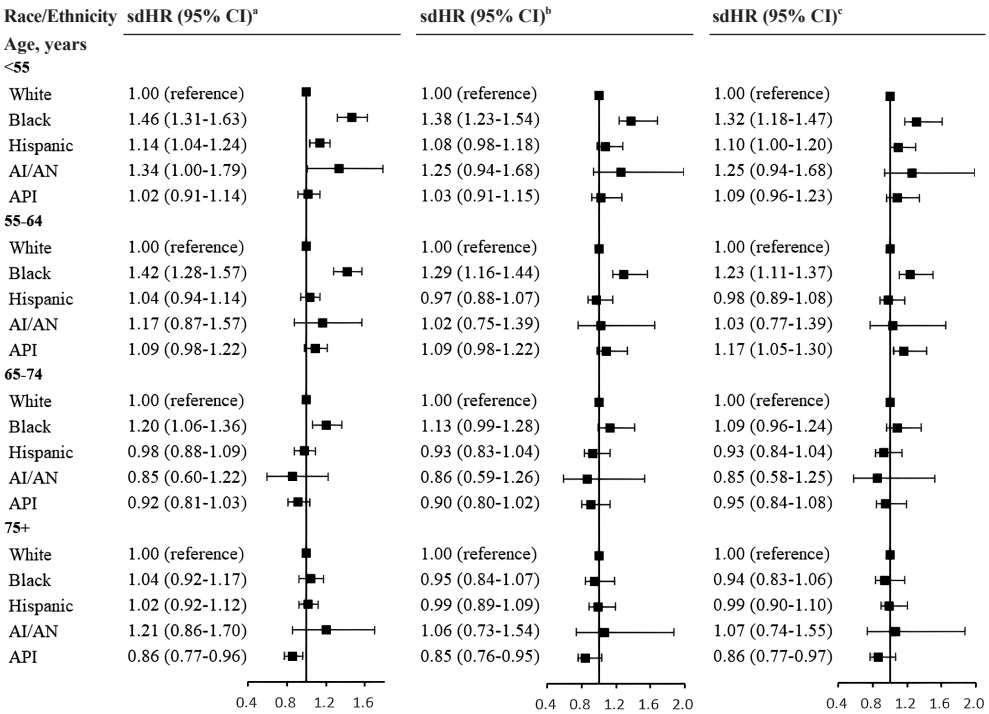

Figure 4 Multivariable-adjusted sdHRs (95% CI) for cancer-specific mortality in rectal cancer associated with race/ethnicity by age at diagnosis. The sdHRs and 95% CIs derived from: [a], Model 1, adjusted for clinical characteristics (gender, tumor grade and stage); [b], Model 2, additionally adjusted for treatment (surgery, radiotherapy and chemotherapy); [c], Model 3, additionally adjusted for factors related to access-to-care (median household income). HR, hazard ratio; CI, confidence interval; AI/AN, American Indian or Alaska Native; API, Asian and Pacific Islander; sdHRs, sub-distribution hazard ratios.

most studies predominantly compare OS between NH-White and NH-Black populations. Our findings align with those from the comprehensive CONCORD-2 study, which remains the largest study in this field to date (15). Involving 241,578 patients, Joseph and colleagues revealed that NH-Black patients with rectal cancer experience higher mortality at 1, 3, and 5 years compared to NH-White patients (15). Supporting our results, another smaller-scale study also observed similar mortality disparities between NH-White and NH-Black rectal cancer patients, especially after adjusting for various factors through propensity score matching (16). It's hypothesized that these disparities in cancer outcomes may be partially linked to socioeconomic disadvantages, which are disproportionately higher among NH-Black populations. This could lead to inferior quality of cancer care (17-19). In our analysis, a greater proportion of NH-Black patients were found to live in low-income situations compared to their NH-White counterparts. Additionally, even though similar percentages of patients received chemotherapy and radiation, a higher percentage of NH-Black patients did not undergo surgery. Prior research also highlights that NH-Black patients often show lower adherence to recommended locoregional or systemic treatments and might experience less effective communication with healthcare providers, factors that could further exacerbate survival outcomes (19-21).

Despite no apparent disparities in rectal cancer-specific mortality between NH-White and AI/AN populations overall, our study reveals a significant disparity in mortality among AI/AN patients with lower median household incomes compared to their NH-White counterparts. This disparity is not evident in those with a median household income above $60,000. This observation is consistent with previous research indicating poorer OS among nonwhite rectal cancer patients with lower incomes compared to whites (18). Structural racism has been identified as a fundamental cause of racial health inequities (22). It encompasses the myriad ways in which societies perpetuate racial discrimination through systems such as education, employment, income, and healthcare. These systems

not only foster discriminatory beliefs and values but also inequitably distribute resources, thereby increasing the risk of adverse health outcomes and perpetuating racial group inequity (23). The American Cancer Society has recently put forth a framework to understand and address social determinants to advance health equity in the context of cancer, acknowledging that health-related disparities often originate from social-structural factors (24). Particularly, Black and AI/AN populations, especially those in rural areas, face heightened challenges. They often experience greater poverty, have lower educational attainment, and lack access to quality healthcare. These factors negatively impact lifestyle choices, screening, diagnosis, treatment, and survivorship in cancer care. In our study, we observed that Black and AI/AN patients with rectal cancer consistently had lower household incomes compared to White patients. This finding underscores the undeniable impact of a long history of structural racism and other social and institutional injustices in shaping adverse health determinants, which in turn perpetuate cancer disparities among racial and ethnic minorities. Our findings emphasize the critical need to address the structural, intersectional, and internalized barriers that these minority groups have faced over an extended period.

Moreover, a higher prevalence of KRAS mutations has been observed in NH-Black patients with rectal cancer compared to NH-White patients (25-27). Despite this, the majority of NH-Black patients were not referred for KRAS mutation counseling and/or testing (28,29). This oversight potentially limits their access to molecular targeted treatments, such as EGFR inhibitors, which could be beneficial. Prior studies also reported additional differences in biologic characteristics between racial/ethnic groups with rectal cancer, such as DNA methylation (30). Regrettably, this detailed genetic information is not captured in the SEER database, preventing us from further investigating these hypotheses in our study. Additionally, the increased mortality observed among NH-Black patients with rectal cancer underscores the importance of early diagnosis and detection in this population. This observation lends support to the argument that endoscopic screening for NH-Black populations should commence earlier than currently recommended by existing guidelines, potentially improving early detection and treatment outcomes (31,32).

In our research, we found that over one-fifth of rectal cancer patients presented with distant metastases at the time of diagnosis. This advanced stage necessitates more complex systemic treatments, such as dose-dense or high-dose regimens, and requires a higher standard of care. The effectiveness of these treatments is often heavily influenced by factors related to healthcare accessibility. Patients diagnosed with early-stage rectal cancer generally have favorable outcomes, with 5-year survival rates exceeding 90%. In contrast, the prognosis for patients with metastatic cancers is significantly less optimistic. Even with optimal systemic therapy, fewer than 15% of these patients survive beyond five years. This stark contrast in survival highlights the critical importance of early detection and access to quality healthcare in improving outcomes for rectal cancer patients (33-35).

Disparities in rectal cancer outcomes between NH-white and Hispanic, as well as Asian patients have not been extensively documented. A study by Berger and colleagues revealed that, from 1988–2003, Hispanics and Native Americans with locoregional rectal cancer experienced lower disease-specific survival compared to whites. However, this disparity was not observed in the period from 2004–2012. Interestingly, during the latter period, Asians with stage I–III rectal cancer demonstrated superior disease-specific survival compared to whites (36). Another study highlighted that Asians had the highest OS and a lower risk of mortality compared to White patients after univariate Cox proportional hazard regression. Yet, this association was no longer significant when adjusting for factors such as age, sex, immigration status, tumor grade, disease extent, treatment, and socioeconomic status (37). In our current analysis, which utilizes the most recent data, we found no significant disparities in outcomes for Hispanic and Asian patients compared to NH-White patients. This observation holds even after adjusting for treatment and factors related to healthcare access. This suggests a potential improvement or equalization in rectal cancer care and outcomes among these ethnic groups in more recent years.

Two key strengths of our study are its substantial sample size and high level of generalizability, derived from utilizing national registry data. This data encompasses approximately 26.5% of the total U.S. population. Our study incorporated data from nearly 55,000 patients registered in the SEER program, diagnosed with rectal cancer between 2011 and 2020. The extensive reach of the SEER database significantly enhances the representativeness and applicability of our findings. Furthermore, our research methodically examined mortality disparities across five major racial/ethnic groups. It also thoroughly considered a comprehensive array of factors, including clinical characteristics, treatment, and aspects related to access-

to-care. Our study presents certain limitations. Firstly, we were unable to access individual-level socioeconomic data such as insurance status and educational attainment. This restriction hindered our ability to delve deeper into the socioeconomic factors influencing racial and ethnic disparities. Secondly, other potential confounding factors like biological attributes, lifestyle habits, comorbid conditions, and detailed treatment protocols could partially account for the observed racial/ethnic disparities. Unfortunately, we did not have access to these detailed datasets, leaving a significant portion of these disparities unexplained. Specifically, we could not assess the relative impact of biological factors. Thirdly, we acknowledge the possibility of misclassification errors in the cause of death and racial/ethnic categorization in population-based cancer registries. Fourthly, our analysis was confined to racial and ethnic disparities in rectal cancer outcomes within the US. Considering rectal cancer's increasing epidemiological importance globally, there is a pressing need to characterize these disparities on a worldwide scale. This study represents a vital step towards future research aimed at understanding the global impact of race and ethnicity on rectal cancer outcomes.

Conclusions

In conclusion, even after adjusting for clinical characteristics, treatment, and factors related to access to care, a significant disparity remains between NH-Black and NH-White patients in rectal cancer-specific mortality. It is crucial to conduct further research to comprehend why NH-Black patients exhibit higher mortality rates compared to NH-White patients and to uncover the underlying biological mechanisms driving this disparity. Our findings underscore the necessity of providing equitable healthcare to eradicate the Black-White disparity in rectal cancer mortality. They also highlight the need for further investigation into additional factors influencing rectal cancer outcomes.

Acknowledgments

The authors are grateful to all researchers and students who worked on this project and made it possible.
Funding: This work was supported by National Natural Science Foundation of China (No. 82260938), Natural Science Foundation of Jiangsu Province of China (No. BK20201093), and Science and technology research project of Jiangxi Provincial Department of Education (No. GJJ2200988).

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://tgh.amegroups.com/article/view/10.21037/tgh-24-1/rc

Peer Review File: Available at https://tgh.amegroups.com/article/view/10.21037/tgh-24-1/prf

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://tgh.amegroups.com/article/view/10.21037/tgh-24-1/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

References

1. Siegel RL, Miller KD, Wagle NS, et al. Cancer statistics, 2023. CA Cancer J Clin 2023;73:17-48.
2. Bahadoer RR, Dijkstra EA, van Etten B, et al. Short-course radiotherapy followed by chemotherapy before total mesorectal excision (TME) versus preoperative chemoradiotherapy, TME, and optional adjuvant chemotherapy in locally advanced rectal cancer (RAPIDO): a randomised, open-label, phase 3 trial. Lancet Oncol 2021;22:29-42.
3. Conroy T, Bosset JF, Etienne PL, et al. Neoadjuvant chemotherapy with FOLFIRINOX and preoperative chemoradiotherapy for patients with locally advanced rectal cancer (UNICANCER-PRODIGE 23): a

multicentre, randomised, open-label, phase 3 trial. Lancet Oncol 2021;22:702-15.
4. Ghaffarpasand E, Welten VM, Fields AC, et al. Racial and Socioeconomic Disparities After Surgical Resection for Rectal Cancer. J Surg Res 2020;256:449-57.
5. Lu PW, Scully RE, Fields AC, et al. Racial Disparities in Treatment for Rectal Cancer at Minority-Serving Hospitals. J Gastrointest Surg 2021;25:1847-56.
6. Halpern MT, Holden DJ. Disparities in timeliness of care for U.S. Medicare patients diagnosed with cancer. Curr Oncol 2012;19:e404-13.
7. Sineshaw HM, Ng K, Flanders WD, et al. Factors That Contribute to Differences in Survival of Black vs White Patients With Colorectal Cancer. Gastroenterology 2018;154:906-915.e7.
8. Lee W, Nelson R, Akmal Y, et al. Racial and ethnic disparities in outcomes with radiation therapy for rectal adenocarcinoma. Int J Colorectal Dis 2012;27:737-49.
9. Vassantachart A, Marietta M, Mehta S, et al. Racial disparities and standard treatment in locally advanced rectal cancer: a National Cancer Database study. J Gastrointest Oncol 2022;13:2922-37.
10. Latouche A, Allignol A, Beyersmann J, et al. A competing risks analysis should report results on all cause-specific hazards and cumulative incidence functions. J Clin Epidemiol 2013;66:648-53.
11. Putter H, Schumacher M, van Houwelingen HC. On the relation between the cause-specific hazard and the subdistribution rate for competing risks data: The Fine-Gray model revisited. Biom J 2020;62:790-807.
12. Fine JP, Gray RJ. A proportional hazards model for the sub-distribution of a competing risk. Journal of the American Statistical Association 1999;94:496-509.
13. Lau B, Cole SR, Gange SJ. Competing risk regression models for epidemiologic data. Am J Epidemiol 2009;170:244-56.
14. Austin PC, Lee DS, Fine JP. Introduction to the Analysis of Survival Data in the Presence of Competing Risks. Circulation 2016;133:601-9.
15. Joseph DA, Johnson CJ, White A, et al. Rectal cancer survival in the United States by race and stage, 2001 to 2009: Findings from the CONCORD-2 study. Cancer 2017;123 Suppl 24:5037-58.
16. Daly MC, Jung AD, Hanseman DJ, et al. Surviving rectal cancer: examination of racial disparities surrounding access to care. J Surg Res 2017;211:100-6.
17. Zeng H, Xu M, Xie Y, et al. Racial/ethnic disparities in the cause of death among patients with prostate cancer in the United States from 1995 to 2019: a population-based retrospective cohort study. EClinicalMedicine 2023;62:102138.
18. Nitzkorski JR, Willis AI, Nick D, et al. Association of race and socioeconomic status and outcomes of patients with rectal cancer. Ann Surg Oncol 2013;20:1142-7.
19. Lee DY, Teng A, Pedersen RC, et al. Racial and Socioeconomic Treatment Disparities in Adolescents and Young Adults with Stage II-III Rectal Cancer. Ann Surg Oncol 2017;24:311-8.
20. Shavers VL, Brown ML. Racial and ethnic disparities in the receipt of cancer treatment. J Natl Cancer Inst 2002;94:334-57.
21. Ofshteyn A, Bingmer K, Towe CW, et al. Robotic proctectomy for rectal cancer in the US: a skewed population. Surg Endosc 2020;34:2651-6.
22. Phelan JC, Link BG, Tehranifar P. Social conditions as fundamental causes of health inequalities: theory, evidence, and policy implications. J Health Soc Behav 2010;51 Suppl:S28-40.
23. Krieger N. Theories for social epidemiology in the 21st century: an ecosocial perspective. Int J Epidemiol 2001;30:668-77.
24. Alcaraz KI, Wiedt TL, Daniels EC, et al. Understanding and addressing social determinants to advance cancer health equity in the United States: A blueprint for practice, research, and policy. CA Cancer J Clin 2020;70:31-46.
25. Lawler T, Parlato L, Warren Andersen S. Racial disparities in colorectal cancer clinicopathological and molecular tumor characteristics: a systematic review. Cancer Causes Control 2024;35:223-39.
26. Hein DM, Deng W, Bleile M, et al. Racial and Ethnic Differences in Genomic Profiling of Early Onset Colorectal Cancer. J Natl Cancer Inst 2022;114:775-8.
27. Booker BD, Markt SC, Schumacher FR, et al. Variation in KRAS/NRAS/BRAF-Mutation Status by Age, Sex, and Race/Ethnicity Among a Large Cohort of Patients with Metastatic Colorectal Cancer (mCRC). J Gastrointest Cancer 2024;55:237-46.
28. Rutter CM, Nascimento de Lima P, Maerzluft CE, et al. Black-White disparities in colorectal cancer outcomes: a simulation study of screening benefit. J Natl Cancer Inst Monogr 2023;2023:196-203.
29. Dharwadkar P, Greenan G, Stoffel EM, et al. Racial and Ethnic Disparities in Germline Genetic Testing of Patients With Young-Onset Colorectal Cancer. Clin Gastroenterol Hepatol 2022;20:353-361.e3.
30. Devall MA, Sun X, Eaton S, et al. A Race-Specific,

DNA Methylation Analysis of Aging in Normal Rectum: Implications for the Biology of Aging and Its Relationship to Rectal Cancer. Cancers (Basel) 2022;15:45.
31. American Cancer Society updates its colorectal cancer screening guideline: New recommendation is to start screening at age 45 years. Cancer 2018;124:3631-2.
32. Summaries for patients. Screening for colorectal cancer: a guidance statement from the American College of Physicians. Ann Intern Med 2012;156:I30.
33. Keller DS, Berho M, Perez RO, et al. The multidisciplinary management of rectal cancer. Nat Rev Gastroenterol Hepatol 2020;17:414-29.
34. Schlechter BL. Management of Rectal Cancer. Hematol Oncol Clin North Am 2022;36:521-37.
35. Wilkinson N. Management of Rectal Cancer. Surg Clin North Am 2020;100:615-28.
36. Berger MD, Yang D, Sunakawa Y, et al. Impact of sex, age, and ethnicity/race on the survival of patients with rectal cancer in the United States from 1988 to 2012. Oncotarget 2016;7:53668-78.
37. Kim J, Artinyan A, Mailey B, et al. An interaction of race and ethnicity with socioeconomic status in rectal cancer outcomes. Ann Surg 2011;253:647-54.

doi: 10.21037/tgh-24-1
Cite this article as: Li L, Xu Z, Chen G, Zhang L, Lu Z, Chen C, Chen Y. Recent racial/ethnic disparities in cancer-specific mortality among patients diagnosed with rectal cancer. Transl Gastroenterol Hepatol 2024;9:37.