Survival Difference of Colorectal Adenocarcinoma Among Racial and Ethnic Minority Groups: A SEER Database Study

Arvin Jeremy Tan MD; Chuong Tran MD; Nurlan Aliyev MD;
Fedja Rochling M.B., B.Ch., (NUI), M.B.A.; Tomoki Sempokuya MD

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Abstract

Despite advances in diagnosis and treatment, racial disparities continue to exist in colorectal cancer (CRC) survival. This study aims to characterize the CRC survival differences among racial and ethnic minority groups. The Surveillance, Epidemiology, and End Results (SEER) database was used to identify adults diagnosed with CRC from 2015 to 2019. Demographics, disease characteristics, surgical treatment, stages, and survival data for individuals who are Hispanic, Black, Southeast Asian, Chinese, American Indian and Alaskan Native (AIAN), Asian Indian and Pakistani (AIP), and Native Hawaiian and Other Pacific Islanders (NHOPI) were extracted. Survival analysis was done using the Kaplan-Meier survival curve. Multivariate analysis was done with the Cox proportional hazard model. There were 40 091 individuals with CRC. NHOPI had the youngest median age of 59 years, while Chinese individuals had the oldest median age of 65 years. From the total sample of their respective subgroups, 43.8% of Black patients and 36.7% of AIAN patients had a median household income of <$60 000, while 55.3% of Southeast Asian patients, 59.7% of Chinese patients, 55.8% of AIP patients, and 65.6% of NHOPI patient had a median household income >$70 000. The 1-year survival rate was lower for patients who were Hispanic (62.0%), Black (60.9%), and AIAN (63.1%). Even after multivariate analysis, Black patients had a significant hazard ratio (HR) of 1.21 (95% confidence interval [95% CI]: 1.05-1.38), while AIP had a HR of 0.68 (95% CI 0.55-0.84), compared to AIAN. Other significant variables that were linked with survival included older age, advanced stage of CRC, a median household income <$60 000, male sex, no surgery, subtotal colectomy/hemicolectomy, and total colectomy. Further studies are needed to elucidate the specific causes of these differences and create appropriate strategies to reduce this survival disparity.

Keywords

colon cancer, survival, health disparities, racial and ethnic minoritized groups, Native Hawaiian and Other Pacific Islanders, American Indian/Alaskan Native, Asian Indian/Pakistani

Abbreviations

AIAN = American Indian and Alaskan Native
AIP = Asian Indian and Pakistani
AJCC = American Joint Committee on Cancer
CRC = colorectal cancer
HR = hazard ratio
NHOPI = Native Hawaiians and Other Pacific Islanders
NOS = not otherwise specified
SEER database = Surveillance, Epidemiology, and End Results database

Introduction

Colorectal cancer (CRC) remains the second most common cause of cancer-related death in the US.[1] Increased awareness through public campaigns and advances in treatment have improved the overall survival of patients with CRC since 1990. The 5-year relative survival rate ranges from 91% for localized disease to 14% for advanced CRC, and the most recent data showed that mortality due to CRC decreased annually by 2% from 2011 to 2022. Importantly, these studies have suggested the presence of racial disparities in CRC survival.

In comparison to White and all other races combined, CRC incidence and mortality are higher in patients who are Black and American Indian and Alaskan Native (AIAN), and lower in Asian and Pacific Islander and Hispanic groups.[1] The observed disparities are greater among men, with death rates 46% higher in AIAN men and 44% higher among Black men compared with White men.[1] Black patients have a lower 5-year survival compared to White patients with an absolute difference of 9.9%, partly due to genetic factors, socioeconomic status, treatment bias, and poor access to health care.[2-6] Despite advances in CRC screening and treatment, the year 5-year survival rate among Black patients with metastatic disease remained stagnant at 21% to 22%.[2-3] Notably, patients who are Alaska Natives are disproportionately affected, with a 2 times higher incidence and 3 times higher mortality rate in comparison to White patients. These disparities have been exacerbated by the recent COVID-19 pandemic.[7]

In genetic studies, Govindarajan et al found no difference in gene expression or clinical characteristics when comparing the gene panel from Black and White patients with Stage II CRC.[8] On the other hand, a comparison of Americans of European vs African descent with CRC found 10 genes that implicate gene expression in racial disparities in CRC, with significant differences in the degree of inflammation due to colorectal cancer.[9] It is also suggested a higher rate of KRAS mutation in Black patients contributes to the disparity seen in outcomes in CRC, primarily due to higher resistance to current existing therapies.[10] Even in these genomic studies, however, minority populations are underrepresented and under-categorized, limiting the advancement in understanding. This remains a major obstacle to improving CRC patient outcomes.[11]

To date, there is a paucity of data regarding CRC survival among different racial and ethnic minority groups. Broadly defined racial categories cannot accurately define the data on CRC incidence, mortality, and survival.[1] This study aimed to characterize the survival differences of colorectal adenocarcinoma among racial and ethnic minority groups.

Methods

Study Design

This study utilized the Surveillance, Epidemiology, and End Results (SEER) database, published by the National Cancer Institute from 2015 to 2019. The SEER database (SEER*Stat 8.4.0), which covers approximately 34.6% of all US cancer cases, has collected population-based data on cancer incidence, stages, tumor characteristics, treatment, and survival since 1973.[12] Specifically, this study utilized the SEER 17 dataset, which contains data from registries from the following areas: Alaska Native Tumor Registry, Atlanta, Greater Georgia, Rural Georgia, Connecticut, Hawai'i, Iowa, Kentucky, Los Angeles, Greater California, Louisiana, New Jersey, New Mexico, San Francisco-Oakland, San Jose-Monterey, Seattle-Puget Sound, and Utah (More details are available at seer.cancer.gov). This study followed the SEER Research Data Use Agreement. In light of the utilization of a publicly available, de-identified database, approval from an Institutional Review Board was not required to conduct this study.

Population

Adult patients (ages 18-84 years) who were diagnosed with colorectal adenocarcinoma from 2015 to 2019 were identfied using International Classification of Diseases for Oncology (ICD-O) codes and histology codes which identify the type of cancer based on the type of cell. The ICD-O-3 site codes are a form classification that refer to the location where the cancer was identified, while the histology codes refer to the type of cancer based on the type of cell. Cancers with an ICD-O-3 site code C18.0-18.9 (cecum, appendix, ascending colon, hepatic flexure of colon, transverse colon, splenic flexure of colon, descending colon, sigmoid colon, overlapping lesion of colon, colon, or not otherwise specified [NOS], respectively), C19.9 (rectosigmoid junction), and C20.9 (rectum, NOS) were included. In addition, the following histology codes were included: 8140/3 (adenocarcinoma, NOS), 8144/3 (adenocarcinoma, intestinal type), 8220/3 (adenocarcinoma in adenomatous polyposis coli), 8221/3 (adenocarcinoma in multiple adenomatous polyps), 8255/3 (adenocarcinoma with mixed subtypes), 8261/3 (adenocarcinoma in villous adenoma), 8263/3 (adenocarcinoma in tubulovillous adenoma), 8570/3 (adenocarcinoma with squamous metaplasia), 8571/3 (adenocarcinoma with cartilaginous and osseous metaplasia), 8572/3 (adenocarcinoma with spindle cell metaplasia), and 8573/3 (adenocarcinoma with apocrine metaplasia). Anal gland adenocarcinoma and neuroendocrine tumors were excluded.

Data

Data on demographics (age at the time of diagnosis, sex, race/ethnicity), residential area (Metropolitan areas >1 million residents, metropolitan areas <1 million residents, suburban: areas adjacent to metropolitan areas, rural: areas non-adjacent to metropolitan areas, or unknown), median household income (<$60 000, $60 000-75 000, >$75 000), staging by American Joint Committee on Cancer (AJCC) Staging Manual, 6th edition (Stage I, II, III, IV, and unknown),[13] SEER stages (localized, regional, distant, unknown), surgical treatment, and survival were collected. Data for patients who were Hispanic, Black, Southeast Asian, Chinese, AIAN, Asian Indian and Pakistani (AIP), and Native Hawaiian and Other Pacific Islanders (NHOPI) were then extracted. Whites were excluded as this study focused on racial and ethnic minority groups. Unknown races, Asians with unknown ethnic origin, and patients whose surgical status was unknown were excluded due to challenges of accurate categorization and analysis. Due to the limited number of patients, those with unknown survival (12 cases), unknown income (3 cases), and the ethnicities Japanese or Korean were also excluded. Data on chemotherapy and interventional therapy was not included due to limitations acknowledged by the SEER database to avoid data inaccuracy.

Statistical Analysis

Statistical analysis was performed with R version 3.4.1 (The R foundation for Statistical Computing, Vienna, Austria), and EZR version 1.36 (Division of Hematology, Saitama Medical Center, Jichi Medical University, Japan).[14] The Chi-Square test was used to compare categorical variables. The Mann-Whitney U test compared continuous variables. Survival analysis was done using the Kaplan-Meier survival curve. Multivariate analysis was done with Cox proportional hazard model. A $P<.05$ was defined as statistically significant.

Results

A total of 40 091 ethnic minority patients with colorectal adenocarcinoma were identified. Baseline characteristics are listed in **Table 1**. The median age of the entire population was 62. There were 1089 AIAN, 917 AIP, 14 492 Black, 2175 Chinese, 16 846 Hispanic, 845 NHOPI, and 3727 Southeast Asian patients. NHOPI had the youngest median age of 59, while Chinese patients had the oldest median age of 65. More than 50% of the sample were males across all ethnic minority subgroups. Sixty-six percent of the sample across all ethnic groups lived in metropolitan areas with a population greater than 1 million. From the total sample of their respective subgroups, 43.8% of Black patients and 36.7% of AIAN patients had a median household income of < $60 000, while 55.3% of Southeast Asian patients, 59.7% of Chinese patients, 55.8% of AIP patients, and 65.6% of NHOPI patients had a median household income >$75 000. **Figure 1** represents the median survival among different ethnicities. AIP had a higher prob-

Table 1. Demographics of Minority Adults with Colorectal Cancer, Surveillance, Epidemiology, and End Results (SEER) Database, 2015-2019									
Characteristic	**All Ethnic Groups**	**Hispanic**	**Black**	**Southeast Asian**	**Chinese**	**AIAN**	**AIP**	**NHOPI**	***P*-value**
N	40 091	16 846	14 492	3727	2175	1089	917	845	
Median Age [Range]	62 [18, 84]	61 [18, 84]	63 [18, 84]	63 [20, 84]	65 [21, 84]	63 [20, 84]	61 [25, 84]	59 [25, 84]	**<.001**
Age Group									
<50	6474 (16.1)	3206 (19.0)	1931 (13.3)	521 (14.0)	270 (12.4)	158 (14.5)	215 (23.4)	173 (20.5)	**<.001**
50-59	10 223 (25.5)	4435 (26.3)	3667 (25.3)	914 (24.5)	467 (21.5)	273 (25.1)	203 (22.1)	264 (31.2)	
60-69	11 869 (29.6)	4717 (28.0)	4602 (31.8)	1112 (29.8)	650 (29.9)	334 (30.7)	248 (27.0)	206 (24.4)	
>70	11 525 (28.7)	4488 (26.6)	4292 (29.6)	1180 (31.7)	788 (36.2)	324 (29.8)	251 (27.4)	202 (23.9)	
Sex (%)									
Male	21 843 (54.5)	9368 (55.6)	7665 (52.9)	2053 (55.1)	1166 (53.6)	550 (50.5)	568 (61.9)	473 (56.0)	**<.001**
AJCC Stage (%)									
I	1329 (3.3)	533 (3.2)	490 (3.4)	130 (3.5)	84 (3.9)	43 (3.9)	23 (2.5)	26 (3.1)	**<.001**
II	5185 (12.9)	2294 (13.6)	1808 (12.5)	455 (12.2)	266 (12.2)	142 (13.0)	130 (14.2)	90 (10.7)	
III	6525 (16.3)	2811 (16.7)	2221 (15.3)	632 (17.0)	366 (16.8)	178 (16.3)	164 (17.9)	153 (18.1)	
IV	5353 (13.4)	2103 (12.5)	2168 (15.0)	496 (13.3)	242 (11.1)	129 (11.8)	87 (9.5)	128 (15.1)	
Unknown	21 699 (54.1)	9105 (54.0)	7805 (53.9)	2014 (54.0)	1217 (56.0)	597 (54.8)	513 (55.9)	448 (53.0)	
Median Household Income (%)									
<$60 000	10 501 (26.2)	3328 (19.8)	6348 (43.8)	232 (6.2)	37 (1.7)	400 (36.7)	97 (10.6)	59 (7.0)	**<.001**
$60-75K	17 201 (42.9)	8823 (52.4)	5325 (36.7)	1434 (38.5)	840 (38.6)	239 (21.9)	308 (33.6)	232 (27.5)	
$75 000+	12 389 (30.9)	4695 (27.9)	2819 (19.5)	2061 (55.3)	1298 (59.7)	450 (41.3)	512 (55.8)	554 (65.6)	
Residential Area (%)									
Metropolitan Areas >1 Million Residents	26 450 (66.0)	11 578 (68.7)	8786 (60.6)	2833 (76.0)	1941 (89.2)	255 (23.4)	743 (81.0)	314 (37.2)	**<.001**
Metropolitan Areas <1 Million Residents	10 635 (26.5)	4529 (26.9)	4163 (28.7)	809 (21.7)	227 (10.4)	306 (28.1)	158 (17.2)	443 (52.4)	
Suburban	1638 (4.1)	370 (2.2)	1148 (7.9)	15 (0.4)	2 (0.1)	87 (8.0)	13 (1.4)	3 (0.4)	
Rural	1070 (2.7)	367 (2.2)	395 (2.7)	70 (1.9)	5 (0.2)	145 (13.3)	3 (0.3)	85 (10.1)	
SEER Stage (%)									
Localized	6877 (17.2)	2818 (16.7)	2590 (17.9)	564 (15.1)	409 (18.8)	209 (19.2)	155 (16.9)	132 (15.6)	**<.001**
Regional	9276 (23.1)	4028 (23.9)	3047 (21.0)	966 (25.9)	569 (26.2)	236 (21.7)	226 (24.6)	204 (24.1)	
Distant	5789 (14.4)	2260 (13.4)	2352 (16.2)	538 (14.4)	249 (11.4)	171 (15.7)	107 (11.7)	112 (13.3)	
Unknown	18 149 (45.3)	7740 (45.9)	6503 (44.9)	1659 (44.5)	948 (43.6)	473 (43.4)	429 (46.8)	397 (47.0)	
Surgery (%)									
Local tumor Excision	1966 (4.9)	810 (4.8)	674 (4.7)	196 (5.3)	129 (5.9)	54 (5.0)	55 (6.0)	48 (5.7)	**<.001**
Partial Colectomy	14 345 (35.8)	6437 (38.2)	4124 (28.5)	1670 (44.8)	993 (45.7)	388 (35.6)	380 (41.4)	353 (41.8)	
Subtotal Colectomy/ Hemicolectomy	12 685 (31.6)	4911 (29.2)	5509 (38.0)	873 (23.4)	596 (27.4)	323 (29.7)	249 (27.2)	224 (26.5)	
Total Colectomy	1557 (3.9)	681 (4.0)	531 (3.7)	138 (3.7)	71 (3.3)	60 (5.5)	33 (3.6)	43 (5.1)	
Total Proctocolectomy	238 (0.6)	118 (0.7)	79 (0.5)	16 (0.4)	6 (0.3)	3 (0.3)	15 (1.6)	1 (0.1)	
Surgery NOS	569 (1.4)	262 (1.6)	187 (1.3)	54 (1.4)	27 (1.2)	15 (1.4)	15 (1.6)	9 (1.1)	
None	8731 (21.8)	3627 (21.5)	3388 (23.4)	780 (20.9)	353 (16.2)	246 (22.6)	170 (18.5)	167 (19.8)	

AIAN=American Indian or Alaska Native, AIP= Asian Indian and Pakistani, NHOPI=Native Hawaiian and Other Pacific Islanders
AJCC = American Joint Committee on Cancer, NOS= not otherwise specified

ability of survival compared to Black patients ($P < .01$). This was followed by the Chinese then Southeast Asians, among the Asian subgroups. Even after adjusting for age, sex, race/ethnicity, AJCC stage, median household income, residential area, and type of surgery received (**Table 2**), Black patients had a significant hazard ratio (HR) of 1.21 (95% CI 1.05-1.38), while AIP had a favorable HR of 0.68 (95% CI 0.55-0.84), compared to AIAN. Other significant variables linked with survival in the multivariate analysis include older age (60-69 years: HR=1.34, 95% CI 1.25-1.43, >70 years: HR=2.18, 95% CI 2.05-2.32), advanced stages (II: HR=1.37, 95% CI 1.18-1.60, III: HR=1.87, 95% CI 1.62-2.15, IV: HR=4.57, 95% CI 3.99-5.24, unknown: HR=2.35, 95% CI 2.06-2.67), a median household income <$60 000 (HR=1.12, 95% CI 1.05-1.18), male sex (HR=1.05, 95% CI 1.01-1.09), no surgery (HR=5.48, 95% CI 4.83-6.22), and subtotal colectomy/hemicolectomy (HR=1.25, 95% CI 1.10-1.42) and total colectomy (HR=1.23, 95% CI 1.03-1.45).

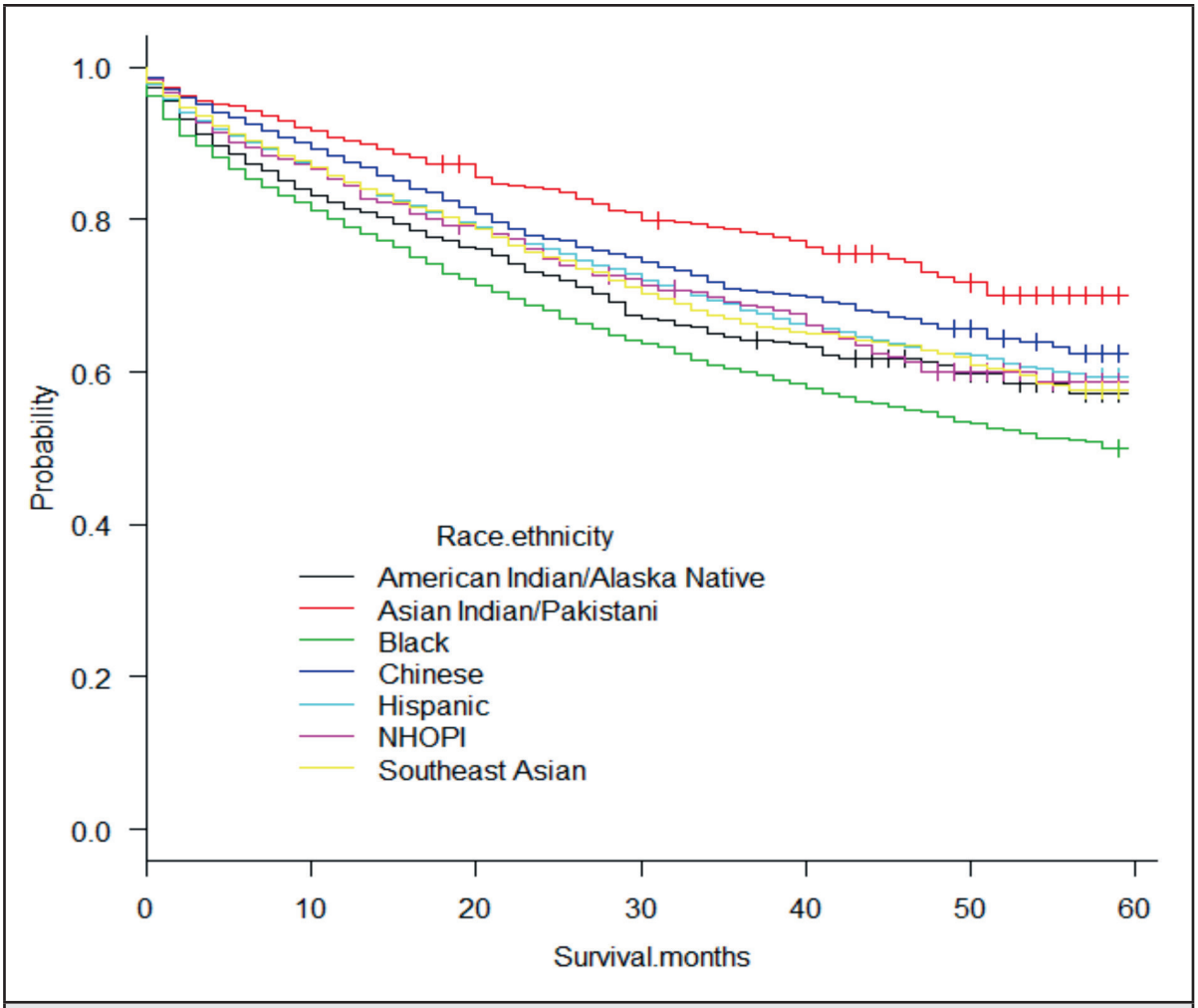

Figure 1. Kaplan-Meier Survival Curve (I <.01) for Colorectal Cancer

Asian Indian/Pakistani patients had the highest survival, while Black patients had the lowest survival. NHOPI = Native Hawaiian and Other Pacific Islanders

Table 2. Multivariate Cox Proportional Hazard Model with Predictors of Colorectal Cancer Survival				
Factor	**Group**	**HR**	**95% CI**	***P*-value**
Age groups	<50	Reference		
	50-59	1.02	0.96-1.10	.51
	60-69	1.34	1.25-1.43	**<.01**
	>70	2.18	2.05-2.32	**<.01**
Sex	Male	1.05	1.01-1.09	**.02**
Race/Ethnicity	American Indian/Alaskan Native	Reference		
	Asian Indian/Pakistani	0.68	0.55-0.84	**<.01**
	African American	1.21	10.5-1.38	**<.01**
	Chinese	0.96	0.82-1.13	.65
	Hispanic	0.98	0.85-1.12	.69
	NHOPI	1.06	0.88-1.28	.55
	Southeast Asian	1.02	0.87-1.18	.85
AJCC Stage	I	Reference		
	II	1.37	1.18-1.60	**<.01**
	III	1.87	1.62-2.15	**<.01**
	IV	4.57	3.99-5.24	**<.01**
	Unknown	2.35	2.06-2.67	**<.01**
Median Household Income	<$60 000	1.12	1.05-1.18	**<.01**
	$60-75K	Reference		
	$75 000+	0.88	0.83-0.92	**<.01**
Residential Area	Metropolitan Areas >1 Million	Reference		
	Metropolitan Areas <1 Million Residents	1.02	0.97-1.08	.41
	Suburban	1.09	0.99-1.20	.08
	Rural	1.06	0.94-1.19	.34
	Unknown	1.39	1.08-1.80	**.01**
Surgery	Local tumor Excision	Reference		
	Partial colectomy	1.11	0.97-1.26	.13
	Subtotal colectomy/hemicolectomy	1.25	1.10-1.42	**<.01**
	Total colectomy	1.23	1.03-1.45	.21
	Total Proctocolectomy	0.85	0.58-1.24	.39
	Surgery NOS	1.88	1.54-2.31	**<.01**
	None	5.48	4.83-6.22	**<.01**

AJCC = American Joint Committee on Cancer, NOS= not otherwise specified

Discussion

This study showed apparent differences in CRC survival among different racial and ethnic minority groups. Notably, Black patients with CRC had a lower probability of survival compared to AIP patients with CRC. In health care disparities research, ethnicities are often grouped together using broad categories. The majority of previous studies made comparisons using broad racial groups- Caucasians, Hispanics, Blacks, and Asians- which maybe an important first step to identifying the existence of disparity. However, this broad categorization of ethnicity may not be appropriate given the diverse and heterogeneous population. There are an estimated 21 million Asian Americans divided into 21 groups listed in the US Census, with the addition of about 800 000 patients identifying as Asian not listed in a category identified under the Census.[15] The current study reflects this diversity and shows significant differences in CRC survival among racial and ethnic minoritized groups. As was shown in a previous study, Black patients have poor CRC survival compared to White patients, even after controlling tumor stage, comorbidities, and sociodemographic factors.[16] It is unclear from the literature, however, whether survival in CRC was worse compared to other racial and ethnic minoritized groups, who may be experiencing similar socioeconomic chal-

lenges. For example, among Asian and Pacific Islander patients who have relatively lower rates of CRC overall, the mortality rates due to CRC are 26% higher among NHOPI men compared to Asian men.[12] Overall, Black and AIAN patients had lower average 5-year survival probability compared to other racial and ethnic minority groups.[17]

The root causes of disparity are often a complex interplay of socioeconomic variables, and a targeted approach to elucidate disparity is needed to improve disparities in health care. The current study showed that there was a survival difference among CRC patients of different Asian subgroups; AIP patients had the highest survival rate, followed by Chinese patients and then Southeast Asians. This is supported by findings in a study done by Medina et al which showed that CRC mortality rate ratios compared to White patients were highest among Southeast Asians, followed by NHOPI, and Koreans.[18] Filipinos, Chinese, Vietnamese, and South Asians fared more favorably. Additionally, foreign-born Asian and Pacific Islander patients have been found to have poorer survival following CRC diagnosis in comparison to US born Asian and Pacific Islander patients.[19] This finding suggests that the categorization of Asians and Pacific Islanders together in racial disparity research may not be appropriate, and Asian groups may need to be subcategorized by ethnicity. These results should be taken into consideration when targeted screening or treatment strategies are developed and implemented for racial and ethnic minoritized groups to improve the survival from CRC to close the disparity gap. A study by Singh et al found that substantial variation in ethnicity categorization contributes to significantly decreased compliance for all CRC screening modalities compared to White patients.[20] Better categorization may prevent policy makers from implementing ineffective strategies in addressing CRC screening compliance.

The cause of differing CRC survival rates among racial and ethnic minority groups is multifactorial. As significant differences exist among minorities within the same racial groups, it is critical to identify disparities among these groups to improve outcomes effectively. Nationwide, the disparities in CRC reflect the differences in access to high-quality and comprehensive health care.[1] CRC screening rates vary among racial and ethnic minority groups, which is attributed to education, cultural behaviors, and socioeconomic status.[21,22] This study found a significantly higher HR among groups with a median household income <$60 000, while patients with a median household income greater than $75 000 and had a higher probability of survival. This may be due to different health care-seeking behaviors by patients with better access to care and more socioeconomic resources. For example, Luo et al found that patients with a higher socioeconomic status had higher adherence to fecal occult blood test-based CRC screening.[23] While race and ethnicity were not included in the analysis, they were identified as likely confounders. Luo et al also noted that with intervention, the disparity in adherence between high vs low SES narrowed.[23]

The challenge of socioeconomic status is complemented by the inadequate or complete absence of insurance coverage being significantly more prevalent in NHOPI (31%), AIAN (29%), and Black patients (19%). Additionally, organizational structures in the current health care market system are disadvantageous to racial and ethnically minority groups.[24] This exacerbates the currently existing disparities. A review by Liu et al found that health disparities in gastrointestinal diseases were likely due to structural and racial discrimination exacerbated by residential racial segregation.[25] They found that most policy-related interventions were ineffective in reducing disparities. A systematic review by Latip et al found that combining methods, including patient navigation, education, and cultural tailoring, is most effective at increasing CRC screening amongst racial and ethnic minority groups.[26]

This study has limitations. First, the retrospective nature of this study is subject to reporting bias, missing data, and coder-to-coder variations. Particularly, this study was unable to provide the correlation between birthplace and nativity among ethnic minority groups. Second, the SEER database did not have accurate information about comorbidities, chemoradiation, and immunotherapy data. Therefore, these data were not included in the analysis. Third, the SEER database is based on 17 States and areas of the US, so generalizability may be limited. Lastly, although this study tried to subcategorize into smaller ethnic groups to decrease the heterogeneity among racial and ethnic minoritized groups, ethnic subgroups, especially Hispanic and AIAN, are known to be heterogeneous.

Conclusion

In conclusion, colon cancer remains one of the leading causes of cancer-related deaths. Despite advances in care, there is a significant survival difference in colorectal adenocarcinoma among racial and ethnic minoritized groups. Further studies are needed to elucidate the specific causes of this difference and create appropriate strategies to reduce this survival disparity.

Conflict of Interest

None of the authors identify a conflict of interest.

Authors' Affiliations:
- Department of Internal Medicine, John A. Burns School of Medicine, University of Hawai'i, Honolulu, HI (AJNT)
- Queen's Liver Center, Queen's Transplant Center, The Queen's Medical Center, Honolulu, HI; Department of Internal Medicine, John A. Burns School of Medicine, University of Hawai'i, Honolulu, HI (CTT)
- Division of Gastroenterology and Hepatology, Department of Internal Medicine, University of Nebraska Medical Center, Omaha, NE (FAR)
- Department of Internal Medicine, University of Nebraska Medical Center, Omaha, NE (NA)
- Queen's Liver Center, Queen's Transplant Center, The Queen's Medical Center, Honolulu, HI; Department of Internal Medicine, John A. Burns School of Medicine, University of Hawai'i, Honolulu, HI (TS)

Corresponding Author:
Tomoki Sempokuya MD; Email: tsempoku@hawaii.edu

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