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ORIGINAL ARTICLE – COLORECTAL CANCER

Colon Cancer Disparities in Stage at Presentation and Time to Surgery for Asian Americans, Native Hawaiians, and Pacific Islanders: A Study with Disaggregated Ethnic Groups

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ABSTRACT

Background. Vast differences in barriers to care exist among Asian American, Native Hawaiian, and Pacific Islander (AANHPI) groups and may manifest as disparities in stage at presentation and access to treatment. Thus, we characterized AANHPI patients with stage 0–IV colon cancer and examined differences in (1) stage at presentation and (2) time to surgery relative to white patients.

Patients and Methods. We assessed all patients in the National Cancer Database (NCDB) with stage 0–IV colon cancer from 2004 to 2016 who identified as white, Chinese, Japanese, Filipino, Native Hawaiian, Korean, Vietnamese, Laotian, Hmong, Kampuchean, Thai, Asian Indian or Pakistani, and Pacific Islander. Multivariable ordinal logistic regression defined adjusted odds ratios (AORs), with 95% confidence intervals (CI), of (1) patients presenting with advanced stage colon cancer and (2) patients with stage 0–III colon cancer receiving surgery at $\geq$ 60 days versus 30–59 days versus $<$ 30 days postdiagnosis, adjusting for sociodemographic/clinical factors.

Results. Among 694,876 patients, Japanese [AOR 1.08 (95% CI 1.01–1.15), $p < 0.05$], Filipino [AOR 1.17 (95% CI 1.09–1.25), $p < 0.001$], Korean [AOR 1.09 (95% CI 1.01–1.18), $p < 0.05$], Laotian [AOR 1.51 (95% CI 1.17–1.95), $p < 0.01$], Kampuchean [AOR 1.33 (95% CI 1.04–1.70), $p < 0.01$], Thai [AOR 1.60 (95% CI 1.22–2.10), $p = 0.001$], and Pacific Islander [AOR 1.41 (95% CI 1.20–1.67), $p < 0.001$] patients were more likely to present with more advanced colon cancer compared with white patients. Chinese [AOR 1.27 (95% CI 1.17–1.38), $p < 0.001$], Japanese [AOR 1.23 (95% CI 1.10–1.37], $p < 0.001$], Filipino [AOR 1.36 (95% CI 1.22–1.52), $p < 0.001$], Korean [AOR 1.16 (95% CI 1.02–1.32), $p < 0.05$], and Vietnamese [AOR 1.55 (95% CI 1.36–1.77), $p < 0.001$] patients were more likely to experience greater time to surgery than white patients. Disparities persisted when comparing among AANHPI subgroups.

Conclusions. Our findings reveal key disparities in stage at presentation and time to surgery by race/ethnicity among AANHPI subgroups. Heterogeneity upon disaggregation

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underscores the importance of examining and addressing access barriers and clinical disparities.

With over 100,000 new cases in 2021 and a 5-year survival rate of 63%,[1] colon cancer is one of the most commonly diagnosed malignancies in the USA, as well as the second-leading cause of cancer-related death. However, the burden of disease is not borne equally: vulnerable populations often experience barriers to colon cancer screening, receive treatment at lower rates, and face greater mortality.[2,3] Such disparities have been identified on the basis of socioeconomic status,[4] insurance coverage,[5] gender,[6] age,[7] and various other sociodemographic factors. Colon cancer disparities among racial and ethnic minority groups, in particular, have been studied along with the differential risk factors and barriers in accessing care that produce these disparities.[8,9] With Black Americans facing among the highest mortality rates from colon cancer, much of the literature on racial health disparities has understandably focused on this patient population. Notably less is known about presentation and treatment disparities among Asian American, Native Hawaiian, and Pacific Islander (AANHPI) patients with colon cancer.

On average, AANHPI men and women experience relatively lower colon cancer incidence and mortality when compared with other racial groups in the United States. Colorectal cancer incidence among AANHPI is 30.0 persons per 100,000 compared with 38.6 persons per 100,000 among non-Hispanic white patients, and 45.7 persons per 100,000 among non-Hispanic Black patients. Similarly, mortality rates for AANHPI (9.5 persons per 100,000) are lower than that of non-Hispanic white patients (13.8 persons per 100,000) and non-Hispanic Black patients (19.0 persons per 100,000).[8] However, much of this data on AANHPI is presented in the aggregate and may mask disparities among its numerous heterogeneous subpopulations: Japanese men, for instance, face a 23% higher incidence of colorectal cancer than non-Hispanic white men, whereas Chinese, Korean, Vietnamese, and Filipino Americans tend to experience a lower incidence of colorectal cancer than non-Hispanic white patients.[8,10] The vast inequities in income and educational attainment among certain AANHPI groups,[11] as well as significant variation in sociocultural beliefs, lifestyles, health behaviors, and barriers to care,[12,13] may manifest in specific presentation and treatment disparities by AANHPI subpopulation. These differences, however, are often neglected and lost in the average, thereby obscuring their significance and undermining efforts to further health equity.

Characterization and granular analysis of the colon cancer burden of disease may elucidate subpopulations of AANHPI patients who face the greatest care disparities and are in most need of improved health policies. The coronavirus disease 2019 (COVID-19) pandemic has highlighted systemic racism against Asian Americans and disproportionate mortality rates among Native Hawaiian and Pacific Islanders,[14,15] both of which have emphasized the need for greater research into the health inequities among AANHPI individuals. Through analysis of the National Cancer Database (NCDB), we sought to provide a comprehensive characterization of Asian American, Native Hawaiian, and Pacific Islander individuals with colon cancer, as well as assess disparities in stage of presentation and time to surgery for these patients. We hypothesized that disaggregated data would reveal key disparities among AANHPI subpopulations.

PATIENTS AND METHODS

Data Source and Patients

The NCDB is a joint project of the Commission on Cancer of the American College of Surgeons and the American Cancer Society, with clinical oncology data sourced from hospital registries of more than 1500 accredited facilities.[16] The data collected from the NCDB are estimated to include more than 70% of newly diagnosed colon cancer cases in the United States[17] and allow for the disaggregation by Asian American subpopulation, given the large sample size.

We performed a retrospective cohort analysis of all patients diagnosed with stage 0, I, II, III, or IV colon cancer from 2004 to 2016 who identified as white, Chinese, Japanese, Filipino, Native Hawaiian, Korean, Vietnamese, Laotian, Hmong, Kampuchean, Thai, Asian Indian or Pakistani, and Pacific Islander. Although we recognize their incredible diversity and heterogeneity, patients who identified as Micronesian, Chamorran, Guamanian, Polynesian, Tahitian, Samoan, Tongan, Melanesian, Fiji Islander, New Guinean, and "Pacific Islander not otherwise specified (NOS)" were grouped together as a single cohort under Pacific Islander, given small sample sizes. Patients with incomplete staging data were excluded.

Clinical and Sociodemographic Covariates

The primary dependent variables of interest were stage of colon cancer upon presentation and the time-to-surgery threshold (≥ 60 days vs. 30–59 days vs. < 30 days between diagnosis and surgery)—distinctions that have been used previously.[18,19] The independent variables studied here included race/ethnicity, age, sex, facility type, median household income for each patient's ZIP code of residence (proxy for socioeconomic status), percentage of adults in the patient's ZIP code who did not graduate from high school (proxy for educational attainment), Charlson–Deyo comorbidity coefficient score, insurance status, and year of diagnosis. Patient data corresponding to income and education made use of quartiles that were derived from the 2012 American Community Survey for each patient's home ZIP code.

Statistical Analysis

Ordinal logistic regressions were employed to compare the effects of the above categorical and quantitative independent variables on ordinal dependent variables. These regression models defined adjusted odds ratios (AOR) with 95% confidence intervals (CI) of (1) patients presenting with advanced stage colon cancer, adjusting for all aforementioned independent variables, and 2) patients receiving surgery at $\geq$ 60 days vs. 30–59 days vs. $<$ 30 days post-diagnosis (AOR $>$ 1 indicates greater odds of delayed time to surgery), adjusting for stage of colon cancer and all aforementioned independent variables.[20] Patients with stage IV colon cancer were excluded from the time-to-surgery model, given that their course of treatment is typically limited to radiation therapy and chemotherapy.[21,22]

Separate models defined AORs with 95% CIs for each primary dependent variable, initially with white patients as the referent group as they represent the largest race/ethnicity group in the NCDB. Subsequently, analyses were conducted in which white patients were excluded from the regression to allow for comparison amongst AANHPI patients with Chinese Americans as the referent, given their large sample size. Analyses were performed with Stata version 16.1 (StataCorp, College Station, TX). This study was determined to be exempt by the institutional review board because of its use of deidentified data.

RESULTS

Baseline Characteristics

Of 694,876 patients with colon cancer included in the study, 43,949 (6.32%) had stage 0, 151,118 (21.75%) had stage I, 185,816 (26.74%) had stage II, 178,290 (25.66%) had stage III, and 135,703 (19.53%) had stage IV disease (Table 1). Median age was 71 [interquartile range (IQR) 60–80] years, and 16,925 patients (2.44%) had no insurance or were on Medicaid. White Americans comprised 97.55% ($N = 677{,}818$), and AANHPI patients comprised

TABLE 1 Baseline cohort characteristics

	Raw N (Raw %)
Total Cohort	694,876
Race	
White	677,818 (97.55)
Chinese	4151 (0.60)
Japanese	2656 (0.38)
Filipino	2590 (0.37)
Native Hawaiian	584 (0.08)
Korean	1880 (0.27)
Vietnamese	1795 (0.26)
Laotian	187 (0.03)
Hmong	87 (0.01)
Kampuchean	197 (0.03)
Thai	170 (0.02)
Asian Indian or Pakistani	2302 (0.33)
Pacific Islander	459 (0.07)
Age (years)	
$\leq$ 39	0 (0)
40–64	235,520 (33.89)
$\geq$ 65	459,356 (66.11)
Median (IQR)	71 (IQR 60–80)
Sex	
Male	341,570 (49.16)
Female	353,306 (50.84)
Stage	
Stage 0	43,949 (6.32)
Stage I	151,118 (21.75)
Stage II	185,816 (26.74)
Stage III	178,290 (25.66)
Stage IV	135,703 (19.53)
Facility type	
Community cancer program	88,824 (12.78)
Comprehensive community cancer program	331,171 (47.66)
Academic/research program	174,849 (25.16)
Integrated network cancer program	100,032 (14.40)
Zip code-wide median household income	
Less than $38,000	101,529 (14.61)
$38,000–$47,999	165,809 (23.86)
$48,000–$62,999	193,521 (27.85)
$63,000 +	234,017 (33.68)
Zip code-wide percent without high school education	
21.0% or more	103,348 (14.87)
13.0–20.9%	174,440 (25.10)
7.0–12.9%	242,027 (34.83)
Less than 7.0%	175,061 (25.19)
Charlson–Deyo comorbidity score	
0	473,186 (68.10)
1	152,932 (22.01)
2	46,736 (6.73)

Table 1 (continued)

	Raw *N* (Raw %)
≥ 3	22,022 (3.17)
Insurance	
Uninsured	16,925 (2.44)
Private insurance/managed care	220,892 (31.79)
Medicaid	25,266 (3.64)
Medicare	416,362 (59.92)
Other government	5,091 (0.73)
Unknown	10,340 (1.49)
Year of diagnosis	
2004	52,305 (7.53)
2005	53,025 (7.63)
2006	52,361 (7.54)
2007	52,478 (7.55)
2008	52,925 (7.62)
2009	51,748 (7.45)
2010	52,537 (7.56)
2011	53,199 (7.66)
2012	53,446 (7.69)
2013	54,894 (7.90)
2014	55,221 (7.95)
2015	55,937 (8.05)
2016	54,800 (7.89)

2.45% ($N = 17{,}058$). Of the 17,058 AANHPI patients, Chinese Americans accounted for 24.33% ($N = 4151$), Japanese 15.57% ($N = 2656$), Filipino 15.18% ($N = 2590$), Native Hawaiian 3.42% ($N = 584$), Korean 11.02% ($N = 1880$), Vietnamese 10.52% ($N = 1795$), Laotian 1.10% ($N = 187$), Hmong 0.51% ($N = 87$), Kampuchean 1.15% ($N = 197$), Thai 1.00% ($N = 170$), Asian Indian or Pakistani 13.50% ($N = 2302$), and Pacific Islander 2.69% ($N = 459$). Disaggregated AANHPI demographic composition by region of origin is presented in Supplementary Table 1.

A comparison of baseline cohort characteristics between white and AANHPI patients is presented in Table 2. On average, white patients were older (white: 71 years vs. AANHPI: 67 years), presented with a higher stage of colon cancer (white: 45.1% at stage III/IV vs. AANHPI: 50.1% at stage III/IV), were less likely to be treated at academic/research programs (white: 24.9% vs. AANHPI: 37.0%), were more likely to reside in areas with the lowest quartile of median household income (white: 14.8% vs. AANHPI: 7.4%) and highest quartile of median education (white: 25.2% vs. AANHPI: 25.0%), had more comorbidities (Charlson–Deyo comorbidity coefficient > 0, white: 32.1% vs. AANHPI: 24.8%), and were less likely to be uninsured or on Medicaid (white: 5.8% vs. AANHPI: 16.4%).

Disparities in Stage at Presentation

Ordinal logistic regression modeling demonstrated that Japanese (AOR 1.08, 95% CI 1.01–1.15, $p < 0.05$; 31.25% at stage III, 16.42% at stage IV), Filipino (AOR 1.17, 95% CI 1.09–1.25, $p < 0.001$; 30.66% at stage III, 21.93% at stage IV), Korean (AOR 1.09, 95% CI 1.01–1.18, $p < 0.05$; 31.76% at stage III, 20.85% at stage IV), Laotian (AOR 1.51, 95% CI 1.17–1.95, $p < 0.01$; 32.62% at stage III, 27.81% at stage IV), Kampuchean (AOR 1.33, 95% CI 1.04–1.70, $p < 0.01$; 32.99% at stage III, 25.38% at stage IV), Thai (AOR 1.60, 95% CI 1.22–2.10, $p = 0.001$; 40.00% at stage III, 27.65% at stage IV), and Pacific Islander (AOR 1.41, 95% CI 1.20–1.67, $p < 0.001$; 28.76% at stage III, 28.54% at stage IV) patients had greater odds of presenting at a higher stage of colon cancer compared with white patients (25.55% at stage III, 19.52% at stage IV) (Figs. 1A, 2A, and Supplementary Table 2). Conversely, Chinese Americans (AOR 0.95, 95% CI 0.90–1.00, $p < 0.05$; 29.99% at stage III, 18.07% at stage IV) were less likely to present at a higher stage of colon cancer than white patients. In subgroup analysis including only AANHPI patients, with Chinese patients as the referent group, Japanese (AOR 1.12, 95% CI 1.02–1.22, $p < 0.05$), Filipino (AOR 1.25, 95% CI 1.14–1.36, $p < 0.001$), Korean (AOR 1.15, 95% CI 1.04–1.27, $p < 0.01$), Laotian (AOR 1.68, 95% CI 1.29–2.19, $p < 0.001$), Hmong (AOR 1.51, 95% CI 1.04–2.20, $p < 0.05$), Kampuchean (AOR 1.51, 95% CI 1.17–1.94, $p < 0.01$), Thai (AOR 1.74, 95% CI 1.32–2.30, $p < 0.001$), and Pacific Islander (AOR 1.50, 95% CI 1.25–1.79, $p < 0.001$) patients were more likely to present at a higher stage of colon cancer (Supplementary Table 3). No significant differences were identified for Native Hawaiian, Vietnamese, and Asian Indian or Pakistani patients.

Disparities in Time-to-Surgery Delay

Ordinal logistic regression modeling demonstrated that Chinese (AOR 1.27, 95% CI 1.17–1.38, $p < 0.001$; 32.22% at ≥ 60 days), Japanese (AOR 1.23, 95% CI 1.10–1.37, $p < 0.001$; 23.80% at ≥ 60 days), Filipino (AOR 1.36, 95% CI 1.22–1.52, $p < 0.001$; 31.27% at ≥ 60 days), Korean (AOR 1.16, 95% CI 1.02–1.32, $p < 0.05$; 30.14% at ≥ 60 days), and Vietnamese (AOR 1.55, 95% CI 1.36–1.77, $p < 0.001$; 33.53% at ≥ 60 days) patients were more likely to experience higher time-to-surgery periods than white patients (24.86% at ≥ 60 days) (Figs. 1B, 2B, and Supplementary Table 4). On subgroup analysis of only AANHPI patients, there was no statistically significant difference between the time-to-surgery threshold between the other ethnic subgroups and Chinese patients, although there was a trend suggesting that Native Hawaiian (AOR

TABLE 2 Baseline cohort characteristics, stratified by race (white vs. AANHPI)

	White	AANHPI	*P* value
Total cohort (%)	677,818 (97.5)	17,058 (2.45)	–
Age (years) (%)			< 0.001
≤ 39	0 (0)	0 (0)	–
40–64	228,007 (33.64)	7513 (44.04)	–
≥ 65	449,811 (66.36)	9545 (55.96)	–
Median (IQR)	71 (IQR 61–80)	67 (IQR 57–76)	–
Sex (%)			0.890
Male	333,194 (49.16)	8376 (49.10)	–
Female	344,624 (50.84)	8682 (50.90)	–
Stage (%)			< 0.001
Stage 0	42,920 (6.33)	1029 (6.03)	–
Stage I	147,777 (21.80)	3341 (19.59)	–
Stage II	181,673 (26.80)	4143 (24.29)	–
Stage III	173,162 (25.55)	5128 (30.06)	–
Stage IV	132,286 (19.52)	3417 (20.03)	–
Facility type (%)			< 0.001
Community cancer program	86,303 (12.73)	2521 (14.78)	–
Comprehensive community cancer program	324,658 (47.90)	6513 (38.18)	–
Academic/research program	168,530 (24.86)	6319 (37.04)	–
Integrated network cancer program	98,327 (14.51)	1705 (10.00)	–
Zip code-wide median household income (%)			< 0.001
Less than $38,000	100,275 (14.79)	1254 (7.35)	–
$38,000–$47,999	163,468 (24.12)	2341 (13.72)	–
$48,000–$62,999	189,055 (27.89)	4466 (26.18)	–
$63,000 +	225,020 (33.20)	8997 (52.74)	–
Zip code-wide percent without high school education (%)			< 0.001
21.0% or more	99,482 (14.68)	3866 (22.66)	–
13.0–20.9%	170,845 (25.21)	3595 (21.08)	–
7.0–12.9%	236,701 (34.92)	5326 (31.22)	–
Less than 7.0%	170,790 (25.20)	4271 (25.04)	–
Charlson–Deyo comorbidity score (%)			< 0.001
0	460,361 (67.92)	12,825 (75.18)	–
1	149,740 (22.09)	3192 (18.71)	–
2	46,035 (6.79)	701 (4.11)	–
≥ 3	21,682 (3.20)	340 (1.99)	–
Insurance (%)			< 0.001
Uninsured	16,090 (2.37)	835 (4.90)	–
Private insurance/managed care	214,259 (31.61)	6633 (38.88)	–
Medicaid	23,302 (3.44)	1964 (11.51)	–
Medicare	409,065 (60.35)	7297 (42.78)	–
Other government	4,994 (0.74)	97 (0.57)	–
Unknown	10,108 (1.49)	232 (1.36)	–
Year of diagnosis (%)			< 0.001
2004	51,266 (7.56)	1039 (6.09)	–
2005	51,953 (7.66)	1072 (6.28)	–
2006	51,295 (7.57)	1066 (6.25)	–
2007	51,378 (7.58)	1100 (6.45)	–
2008	51,797 (7.64)	1128 (6.61)	–

Table 2 (continued)

	White	AANHPI	*P* value
2009	50,539 (7.46)	1209 (7.09)	–
2010	51,242 (7.56)	1295 (7.95)	–
2011	51,884 (7.65)	1315 (7.71)	–
2012	52,007 (7.67)	1439 (8.44)	–
2013	53,343 (7.87)	1551 (9.09)	–
2014	53,662 (7.92)	1559 (9.14)	–
2015	54,333 (8.02)	1604 (9.40)	–
2016	53,119 (7.84)	1681 (9.85)	–

p values were obtained using Pearson's chi-squared test for categorical variables

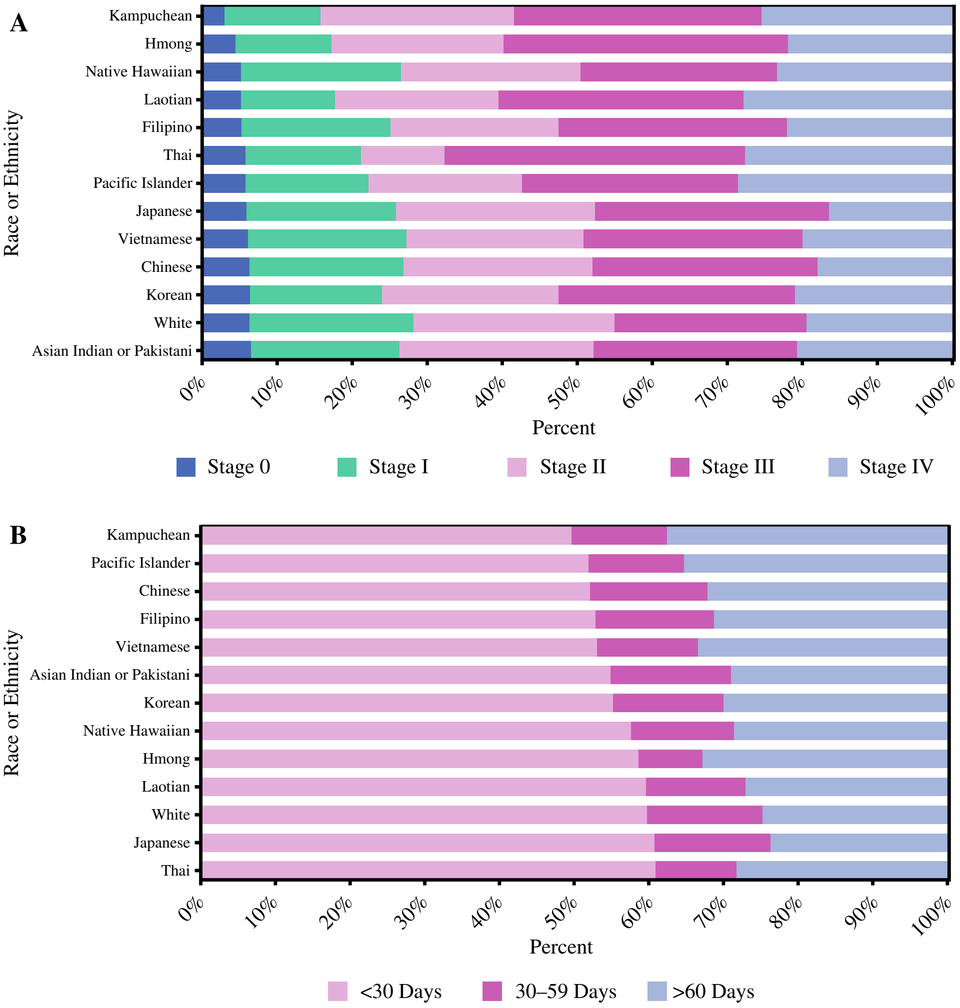


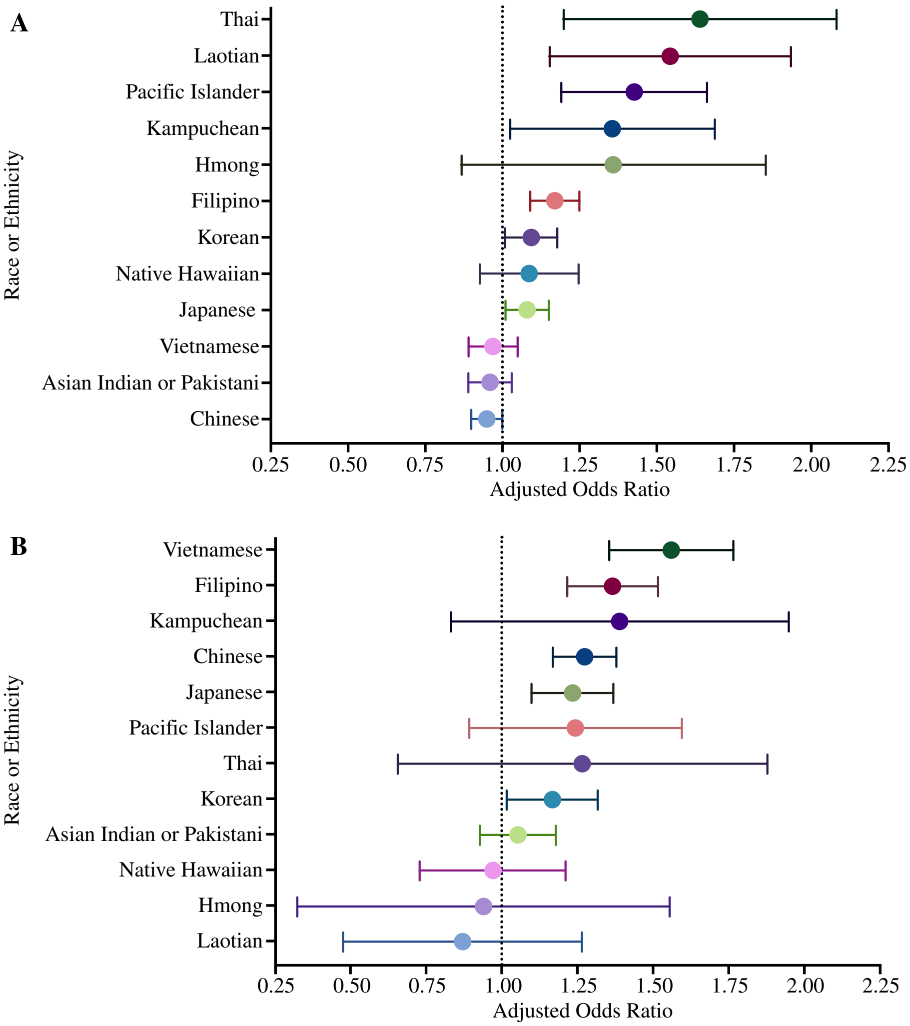
FIG. 1 **A** Proportion of patients with stage 0, I, II, III, or IV colon cancer at presentation, stratified by race/ethnicity. **B** Proportion of patients with stage 0, I, II, or III colon cancer receiving surgery at ≥ 60 days versus 30–59 days versus < 30 days postdiagnosis, stratified by race/ethnicity

0.78, 95% CI 0.60–1.02, $p = 0.071$), Laotian (AOR 0.62, 95% CI 0.39–1.00, $p = 0.052$), and Asian Indian or Pakistani (AOR 0.86, 95% CI 0.74–1.00, $p = 0.053$) patients were less likely to experience treatment delays than Chinese patients (Supplementary Table 5).

DISCUSSION

In this national analysis of 694,876 patients, we comprehensively characterize AANHPI individuals diagnosed with colon cancer and evaluate disparities in stage at presentation and time to surgery. We found that, after

FIG. 2 **A** Adjusted odds ratios (AORs) and 95% confidence intervals (95% CI) comparing the odds of presenting at a progressively higher stage based on AANHPI subgroup (referent—white). **B** Adjusted odds ratios (AORs) and 95% confidence intervals (95% CI) comparing the odds of experiencing treatment delays ($\geq$ 60 days vs. 30–59 days vs. $<$ 30 days postdiagnosis) based on AANHPI subgroup (referent—white)



adjusting for an array of sociodemographic covariates, Japanese, Filipino, Korean, Laotian, Kampuchean, Thai, and Pacific Islander patients, who represented about 50% of the AANHPI cohort, were more likely to present at a higher stage of colon cancer compared with their white counterparts. These disparities were mirrored for Chinese, Japanese, Filipino, Korean, and Vietnamese patients, who represented over 75% of the AANPHI cohort and were more likely to experience longer time-to-surgery delays than white patients, after similarly adjusting for sociodemographic covariates and colon cancer stage. Restricting both analyses to only AANHPI patients, key subgroup disparities were elucidated. Our findings emphasize that AANHPI patients with colon cancer may be more likely to present at a higher stage and to receive delayed treatment, even though, on average, incidence and mortality may be lower among AANHPI individuals relative to white or Black individuals.

To date, few studies have focused on colon cancer disparities among AANHPI individuals and, if so, have primarily considered the population in the aggregate, masking the incredible diversity and heterogeneity of the various subpopulations. Furthermore, there is little research exploring these patients' clinical experiences and barriers in access to care that impact diagnosis and subsequent uptake of treatment. Indeed, much of the healthcare disparity literature on colon cancer focuses on white versus Black populations,[23,24] and these studies are critical to improving population health outcomes for racial minorities. The paucity of focus on health inequities among AANHPI individuals has become all the more apparent as the COVID-19 pandemic fueled anti-Asian xenophobia and hate crimes and disproportionately high mortality rates among Native Hawaiian and Pacific Islanders.[14,15,25–28] Another NCDB analysis revealed similarly widespread disparities in risk group at presentation, as well as access to treatment or active surveillance, for AANHPI patients with localized prostate adenocarcinoma.[20] However, our study is the first to examine clinical care disparities, including stage at presentation and time to surgery, by AANHPI subpopulation for patients with colon cancer. In characterizing AANHPI patients with colon cancer, our study also provides a foundation for future research to build on and discern causative factors underlying these disparities.

Many factors may contribute to our observation that certain AANHPI subgroups, ranging from 50 to 75% of the population, were more likely to present with late-stage disease and face delayed surgery. For one, low colon cancer case rates among AANHPI may drive disparities because of reduced awareness among patients and diagnostic unfamiliarity among clinicians. Indeed, with limited exposure to colon cancer, AANHPI individuals may be less likely to proactively mitigate risk or seek out timely care for colon cancer. Similarly, lack of clinician familiarity with colon cancer in AANHPI individuals can contribute to delayed delivery of preventive services, as well as misdiagnosis. Indeed, healthcare providers are less likely to recommend colon cancer screening to racial minorities,[29] perhaps reflecting certain implicit bias in the differential diagnosis of AANHPI individuals.

Beyond low case rates, social disadvantage may be driving the disparities we found. While Asian Americans are generally studied as a homogeneous group with high rates of educational attainment and economic success, significant within-group differences and healthcare needs exist amongst Asian American subgroups—who have the greatest within-group disparities in socioeconomic status and educational attainment of all groups in the US, particularly affecting many Kampuchean, Hmong, Laotian, and Vietnamese individuals.[30–32] Native Hawaiians similarly often experience lower income and educational attainment,[33,34] paralleling the experiences of Pacific Islanders who identify as Native Chamorros, Māori, Kanak, and others.[33] AANHPI groups also face high rates of disfluency and limited English proficiency,[35] which likely impair access to screening and cancer care. Importantly, educational and socioeconomic disparities in general have been associated with reduced screening and treatment rates, as well as worse postoperative outcomes.[36–39] This greater social disadvantage of AANHPI can be rooted to long histories of racism and discrimination in the USA, but manifests presently in the form of lower health literacy rates, and thus the reduced uptake of preventive care services and treatment. Indeed, multiple studies have found that greater health literacy regarding colon cancer can increase colonoscopy rates and health-seeking behavior more broadly, potentially reducing delays in care.[40–43] Although our models adjusted for sociodemographic factors such as educational attainment, income, and insurance status, social disadvantage in the form of increased exposure to health risks and reduced access to healthy behaviors and care resources may help explain the disparities we found in stage-at-presentation and time-to-surgery delays, as well as provide avenues for policy action.

Our data suggest the need to further personalize screening and treatment regimens in manners that take into consideration race and ethnicity, especially at a granular level for AANHPI individuals. Tailored, culturally competent screening strategies, as have been pursued for Vietnamese,[44] Filipino,[45] Chinese,[46] Pacific Islander,[47] Native Hawaiian,[48] and other AANHPI Americans, should be endorsed to help individuals mitigate risk and should be expanded to help combat treatment disparities as well. Some salient strategies from these studies included multilingual, tailored health education resources, media campaigns within diasporic outlets, care delivery in community contexts, and interactions with racially/ethnically concordant healthcare personnel. These approaches should be further refined and supported to combat stage-at-presentation and delay-to-surgery disparities. Another potential consideration may be developing new screening paradigms for ethnic subgroups at high risk of colon cancer. For instance, Japan and Korea have national gastric cancer screening programs because incidence is especially high, and Stanford's Center for Asian Health Research and Education is working to implement a similar program for Asian Americans in the Bay Area.[49] Finally, more granular race and ethnicity data are needed to better identify AANHPI disparities that might otherwise be masked and lost in the average. Addressing systemic barriers to colon cancer care and measuring progress toward eliminating health disparities necessitates disaggregated, granular data for AANHPI.

There are several limitations to this study that are important to note. First, our retrospective approach may suffer from selection bias and carries the risk of misclassification. Only patients who have access to Commission on Cancer-accredited facilities, which contribute data to the NCDB, are included, such that our findings may in fact underestimate the gravity of the disparities in access. The NCDB, more generally, is limited in the data that are available: there are no data available for patients' preferred language, and there is high prevalence of missing data on patients' overall survival.[50] Furthermore, low sample sizes led us to aggregate Pacific Islanders in spite of the incredible cultural diversity of this group.[51,52] With no information on patients who identify with multiple AANHPI identities, or on cultural preferences, our conclusions are further limited by certain lack of granularity and explanatory power. While the NCDB represents one of the largest available data sources on AANHPI, greater representation of minority racial/ethnic groups in data sources is necessary. Finally, we identified, but could not fully ascertain, the reasons for disparities in stage at presentation and time to surgery. Detailed prospective research will be needed to further investigate these disparities and clarify the mechanisms through which they act.

CONCLUSIONS

Our study uses a disaggregated approach to present a comprehensive understanding of colon cancer stage and treatment disparities among AANHPI patients. Indeed, we elucidated disparities in stage at presentation and time to surgery for Chinese, Japanese, Filipino, Korean, Vietnamese, Laotian, Kampuchean, Thai, and Pacific Islander Americans relative to white patients. Our data emphasize the need for further investigation into various genetic and environmental risk factors, as well as levers of social disadvantage that affect AANHPI patients with colon cancer. Further research investigating and assessing causes of these disparities may improve population-wide outcomes by ensuring all individuals have access to preventive services and timely treatment following diagnosis. Consistent with recommendations from oncology providers and epidemiologists,[28] understanding cultural, sociodemographic, and clinical factors associated with presentation and treatment disparities may promote improved and shared decision making.

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