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Ethnic disparities in early-onset colorectal cancer incidence, screening rates and risk factors prevalence in Guam

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ABSTRACT

Objective: Colorectal cancer (CRC) is one of the four most common cancers and the third leading cause of cancer-related deaths in Guam. This study investigated CRC incidence, screening, and risk factors of early onset CRC across Guam's ethnic groups using data from the Guam Cancer Registry (1998–2020) and the Guam Behavioral Risk Factor Surveillance System (2018–2019).

Methods: Incidence rate ratios (IRRs) were calculated to compare incidence rates across different age groups stratified by sex, ethnicity, and stage. Incidence rate differences (IRDs) were used to test for significant differences across sex and ethnicity. The Pearson chi-square test was used to assess differences in CRC screening rates by age, sex, education, income, healthcare coverage, and ethnicity, and to examine ethnic group disparities in the prevalence of CRC risk factors.

Results: The steepest increase in CRC incidence was observed between the 35–39 and 40–44 age groups (IRR = 2.01; 95 % CI: 1.14–3.53) and between the 40–44 and 45–49 age groups (IRR = 1.99; 95 % CI: 1.34–2.97). CHamorus exhibited rate increases at younger ages compared to Filipinos. CRC screening prevalence and associated risk factors showed considerable variation among ethnicities.

Conclusions: Elevated early-onset CRC rates were observed for both CHamorus and the broader Guam population under 50. The findings support the new recommendation to begin screening at age 45 and efforts to increase screening in Guam.

1. Introduction

Despite the U.S. Preventive Services Task Force's initiatives, there has been a rise in early-onset colorectal cancer (EOCRC) incidence in individuals under 50 years, while rates in those 50 and older are on the decline (Anderson and Samadder, 2018; Abualkhair et al., 2020). From 2000–2002 to 2014–2016, there was a nearly 15 % surge in colorectal cancer (CRC) incidence in adults aged 40–49 years (Siegel et al., 2023). By 2030, the incidence is projected to double in those under 50 (Gausman et al., 2020). In response to rising rates of EOCRC, the American Cancer Society revised its guidelines in 2018, lowering the recommended starting age for screening average-risk individuals from 50 to 45 years. Similarly, the US Preventive Services Task Force updated their recommendations in 2021 to align with these findings (U.S. Preventive Services Task Force, 2021). Between 2000 and 2014, EOCRC mortality rates rose by 13 % (Siegel et al., 2017).

CRC incidence rates exhibit variability based on sex and ethnicity. While men have shown an increased risk for EOCRC, data from the Surveillance, Epidemiology, and End Results (SEER) 18 registries indicate steep incidence increases between 49 and 50 years of age for both women (39.1 %) and men (52.9 %) from 2000 to 2015 (Abualkhair et al., 2020 Jan 3). Racial disparities in EOCRC, especially elevated risks observed among the Black and Asian groups, are well-documented (Akimoto et al., 2021; Muller et al., 2021). However, literature on Pacific Islander populations remains limited.

Several risk factors for EOCRC have been identified, including sex, family history, alcohol, processed meat consumption, and inflammatory bowel disease (Akimoto et al., 2021). The incidence of EOCRC is increasing in many affluent countries influenced by Western culture, such as Australasia, Western European countries, Canada, South Korea, and Japan (Muller et al., 2021). A diet rich in red meat, high in saturated fat, and low in fiber, often linked with Western dietary patterns,

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contributes to obesity, a prominent CRC risk factor (Mehta et al., 2017). This diet is associated with a heightened risk of early-onset advanced adenomas in the distal colon and rectum. The increasing prevalence of obesity in young adults is believed to be linked to the growing incidence of EOCRC. Additionally, type 2 diabetes is suggested as a risk factor specifically for EOCRC, rather than for late-onset CRC (Muller et al., 2021). Previous studies have established a clear association between excess body weight and an elevated risk of colorectal cancer (CRC). Specifically, obese men face a roughly 50 % higher risk of colon cancer and a 25 % increased risk of rectal cancer compared to men with a normal weight. In obese women, the risk of colon cancer increases by approximately 10 %, though no significant increase in rectal cancer risk has been observed (Xue et al., 2017). In November 2009, the International Agency for Research on Cancer confirmed a link between tobacco smoking and CRC (Secretan et al., 2009). Alcohol consumption has also been reported to be responsible for an estimated 13 % of CRC cases in the United States (Islami et al., 2018). Additionally, type 2 diabetes has long been implicated as a significant risk factor for CRC (Deng et al., 2012).

The Pacific region, including the United States-Affiliated Pacific Islands (USAPI), reports some of the world's highest prevalence rates for obesity and type 2 diabetes (Novotny et al., 2022). In 2010, a state of emergency was declared in the USAPI in response to the epidemic of non-communicable diseases (Nitta et al., 2017). The USAPI, which includes Guam, faces high cancer incidence and a lack of resources for cancer prevention and management (Van Dyne et al., 2020).

Guam, the largest Micronesian island and a U.S. territory, is located in the northwestern Pacific Ocean, around 3,700 miles west of Hawai'i and 1,300 miles southeast of Japan. It has a diverse population of around 159,000 residents, consisting of indigenous CHamorus (42.2 %), Filipinos (26.3 %), Chuukese and other Micronesians (7.2 %), Whites (6.8 %), other Asians (6.2 %), and additional ethnic groups (11.3 %) (Hernandez et al., 2017). As the original inhabitants, CHamorus are a central part of Guam's cultural heritage but are typically grouped with other Pacific Islanders in surveys. Similarly, Filipinos, the second largest ethnic group, are aggregated with Asians. A study comparing the CHamoru and Filipino populations in Guam highlighted a significant obesity disparity: 49% of CHamorus were obese compared to 20 % of Filipinos (Leon Guerrero et al., 2008). Although the U.S. has seen a decline in the incidence and/or mortality of breast, prostate, and colorectal cancers, these rates continue to rise in Guam. Particularly, CHamorus experience a higher CRC mortality rate compared to the broader U.S. population (Diaz et al., 2020).

Given the CRC burden and the unique population of Guam, it is critical to investigate the disparities in EOCRC incidence rates. The primary objective of the study is to conduct an incidence analysis in five-year age increments to identify age groups under 50 experiencing the most significant increases in incidence rates. This is particularly important as age 50 has historically been the recommended starting age for initial screening. Finding steep increases in these younger age groups would underscore the need for earlier screening, potentially leading to earlier detection and improved treatment outcomes.

Additionally, we aimed to describe the prevalence of cancer screening behaviors across various demographic groups in Guam and to assess disparities in modifiable EOCRC risk factors (e.g. smoking, obesity, lack of physical activity, and alcohol use), that may contribute to variations in incidence rates among different ethnic groups in Guam. Due to the lack of individual-level risk factor data, our analysis emphasizes population-level differences.

2. Materials and methods

2.1. Participants and data sources

This study utilized de-identified data from Guam Cancer Registry (GCR). Established in 1998 by the 24th Guam Legislature under the Department of Public Health and Social Services, the GCR is a population-based registry documenting all cancer cases among Guam residents. It is affiliated with both the North American Association of Central Cancer Registries (NAACCR) and the U.S. Pacific Regional Central Cancer Registry, ensuring data collection adheres to the rigorous standards set by NAACCR and National Cancer Institute (NCI) Surveillance, Epidemiology, and End Results (SEER) programs (Leon Guerrero et al., 2014). For comparison, we used data from the contiguous United States obtained from the SEER 9-Registry. This registry collects cancer incidence and survival data from nine regions across the U.S., representing approximately 9.4% of the population. Invasive primary CRC cases in individuals aged 35–64 diagnosed between 1998 and 2020 in Guam and between 2000 and 2019 in the US were analyzed. The population estimates for the U.S. were obtained from SEER, while the population size for Guam was estimated using the 2010 Guam Census Data. Stages were classified into localized and late (including regional and distant) stages according to SEER definitions.

The Behavioral Risk Factor Surveillance System (BRFSS) survey data was utilized to estimate the prevalence of CRC screening and risk factors among different demographic groups in Guam. This dataset is weighted to Guam's demographic profile, and all responses are self-reported. Guam incorporated State-Added Questions starting in 2007 to identify its distinct ethnic groups, allowing for detailed subgroup analysis and comparison (Uncangco et al., 2012). In contrast, the Centers for Disease Control and Prevention (CDC) categorizes Native Hawaiians and other Pacific Islanders together. In this study, CRC risk factors among different ethnic groups were assessed using 2019 Guam BRFSS responses from 1,263 adults aged 35–64. Modifiable risk factors for CRC included physical inactivity (Boyle et al., 2012), overweight or obesity (Larsson and Wolk, 2007), smoking (Secretan et al., 2009), alcohol consumption (McNabb et al., 2020), and diabetes (Xue et al., 2017). Additionally, 2018 BRFSS data were utilized to assess CRC screening uptake among eligible adults aged 50–64 years (N = 496).

2.2. Statistical analyses

While the primary focus of this paper is EOCRC, the 55–64 age group was also included to facilitate comparisons between older and younger age groups. This broader perspective helps pinpoint when the steepest increases in incidence occur and how these rates align with the historically recommended screening age of 50. To maintain consistency, a 15-year age interval from 50 to 64 was used, mirroring the 15-year interval from 35 to 49. Rates for individuals under 35 were not examined due to low case counts.

Due to the small number of cases overall, incidence rates were determined in 5-year age groups from 35 to 64, stratified by sex, ethnicity, and stage. Age-specific incidence rates for each age group were calculated. The primary ethnic groups of interest were CHamorus and Filipinos, the two largest in Guam. To identify the biggest increase in CRC incidence, the incidence rate ratios (IRRs) and incidence rate differences (IRDs) with their respective 95% confidence intervals (CIs) were calculated for 5-year age transitions: from 35–39 to 40–44, 40–44 to 45–49, 45–49 to 50–54, 50–54 to 55–59, and 55–59 to 60–64. The IRR was used to assess the relative steepness of the increase, while the IRD was used to measure the absolute change in terms of additional cases. This dual approach ensured that both relative and absolute perspectives were considered, providing a more comprehensive understanding of the incidence trends across age groups. The IRDs and their 95 % CIs were computed to test for significant differences between males and females, CHamorus and Filipinos, and Guam and U.S. age-specific rates. IRDs were analyzed within the same age group across these demographic factors.

The Pearson chi-square test was used to assess differences in CRC screening rates across various factors such as age, sex, education and income level, healthcare coverage, and ethnicity. Furthermore, this test was employed to explore the disparities in the prevalence of established

CRC risk factors between CHamoru and Filipino populations. A P-value of less than 0.05, obtained from two-sided tests, was deemed to indicate statistical significance.

2.3. Ethics statement

This study utilized de-identified data from the Guam Cancer Registry and the BRFSS, which are publicly available upon request. Therefore, it was considered exempt from review by the University of Guam Institutional Review Board.

3. Results

3.1. Descriptive characteristics of the CRC cases

In the years 1998–2020, a total of 877 invasive CRC cases were diagnosed in Guam, with a mean age of 62.0 years (SD 13.4). The mean annual CRC incidence rate during this period was 34.4 per 100,000, age-adjusted to the 2000 standard US population. This study focused exclusively on 453 patients aged 35–64 with the incidence rate of 33.1, age-adjusted to the 2000 standard US population. Among these, 257 cases (56.7 %) were male and 196 (43.3 %) were female. Most cases were CHamoru (230, 50.8 %), followed by Filipino (102, 22.5 %), Asian (37, 8.2 %), White (30, 6.6 %), Other Pacific Islander (32, 7.1 %), and Other or Unknown Ethnicity (22, 4.9 %). Of the cases, 22.5 % were localized, 36.6 % were late-stage, and 40.8% were unstaged. This stage distribution in EOCRC closely matched that of all CRC cases: 23.1 % localized, 34.5% late-stage, and 42.3 % unstaged.

A total of 78,571 malignant CRC cases aged 35–64 were recorded in the contiguous US from 2000 to 2019.

3.2. Incidence rate analysis by ethnicity, sex and stage

The IRRs and IRDs for CRC across different age transitions, sexes, ethnicities, and stages are presented in Table 1. The analysis of all CRC cases aged 35–64 in Guam showed the largest relative increases before the age of 50. Individuals aged 40–44 had a CRC rate 2.01 times higher compared to the 35–39 age group (95 % CI: 1.14, 3.53). Those aged 45–49 had a rate that was 1.99 times higher than those in the 40–44 age group (95 % CI: 1.34, 2.97). The largest absolute increase in Guam was from age 50–54 to 55–59, with an IRD of 34.14 (9 5% CI: 19.31, 48.97). In comparison, within the contiguous United States, the steepest relative increase (IRR = 1.90, 95 % CI: 1.86–1.95) and the largest absolute increase (IRD = 27.41, 95% CI: 26.43, 28.40) occurred from age 45–49 to 50–54.

When stratified by ethnicity, CHamorus had a significantly higher increase in incidence at younger ages than Filipinos. Among the CHamoru population, the steepest relative increase was observed from age group 40–44 to 45–49, in which the CRC incidence rate more than doubled (IRR = 2.11, 95 % CI: 1.16, 3.83). The largest absolute increase occurred from age 50–54 to 55–59 (IRD = 54.43, 95% CI: 24.22, 84.64). For the Filipino population, the steepest relative increase and the largest absolute increase were both recorded from age 55–59 to 60–64, with an IRR of 1.76 (95 % CI: 1.02, 3.05) and an IRD of 26.95 (95% CI: 1.34, 52.57).

Increases in CRC incidence were also analyzed for males and females.

Table 1
Colorectal Cancer Incidence Rate Differences (IRD) and Incidence Rate Ratios (IRR) with 95 % Confidence Intervals (CIs) Among Patients Aged 35–64 in the US Surveillance, Epidemiology, and End Results 9 Registries (2000–2019) and in Guam Cancer Registry (1998–2020), with Guam stratified by Sex, Ethnicity and Staging.

Age groups		US Total	GU Total	Guam incidence stratified					
				Male	Female	CHamoru	Filipino	Localized	Late[a]
35–39 to 40–44	**n**	8801	55	24	31	27	11	7	22
	IRD	7.77	6.94	6.71	7.35	5.79	n/a	n/a	2.18
	95 % CI	(7.23, 8.30)	(1.45, 12.42)	(−0.31, 13.72)	(−1.16, 15.86)	(−5.12, 16.70)	n/a	n/a	(−1.13, 5.48)
	IRR	1.83	2.01	2.27	1.87	1.50	n/a	n/a	1.71
	95 % CI	(1.76, 1.91)	(1.14, 3.53)	(0.94, 5.47)	(0.90, 3.90)	(0.70, 3.23)	n/a	n/a	(0.72, 4.08)
40–44 to 45–49	**n**	16,800	107	49	58	49	23	19	36
	IRD	13.22	13.69	11.90	15.65	19.32	6.18	4.01	3.79
	95 % CI	(12.50, 13.94)	(5.93, 21.45)	(1.94, 21.87)	(3.57, 27.73)	(4.23, 34.42)	(−5.35, 17.70)	(0.82, 7.19)	(−0.65, 8.23)
	IRR	1.77	1.99	1.99	1.99	2.11	1.56	2.95	1.65
	95 % CI	(1.72, 1.83)	(1.34, 2.97)	(1.11, 3.59)	(1.16, 3.42)	(1.16, 3.83)	(0.68, 3.61)	(1.06, 8.19)	(0.85, 3.23)
45–49 to 50–54	**n**	30,363	154	80	74	78	37	33	59
	IRD	27.41	12.20	19.96	3.75	22.01	15.60	3.95	8.37
	95 % CI	(26.43, 28.40)	(1.72, 22.67)	(5.48, 34.44)	(−11.42, 18.92)	(1.15, 42.88)	(−0.18, 31.37)	(−0.97, 8.87)	(1.94, 14.80)
	IRR	1.90	1.44	1.84	1.12	1.60	1.91	1.63	2.02
	95 % CI	(1.86, 1.95)	(1.05, 1.98)	(1.17, 2.87)	(0.71, 1.77)	(1.02, 2.51)	(0.98, 3.71)	(0.82, 3.26)	(1.19, 3.43)
50–54 to 55–59	**n**	40,477	215	135	80	119	44	51	80
	IRD	10.32	34.14	54.95	14.00	54.43	2.45	8.59	7.23
	95 % CI	(9.10, 11.55)	(19.31, 48.97)	(31.75, 78.15)	(−4.33, 32.34)	(24.22, 84.64)	(−17.66, 22.56)	(1.29, 15.88)	(−1.76, 16.21)
	IRR	1.18	1.86	2.25	1.40	1.93	1.07	2.01	1.39
	95 % CI	(1.16, 1.20)	(1.41, 2.45)	(1.58, 3.20)	(0.90, 2.17)	(1.33, 2.79)	(0.59, 1.94)	(1.14, 3.54)	(0.89, 2.15)
55–59 to 60–64	**n**	44,390	244	153	91	125	54	62	85
	IRD	25.35	3.41	−8.60	15.04	−20.31	26.95	3.16	3.79
	95 % CI	(23.86, 26.84)	(−15.59, 22.41)	(−38.81, 21.60)	(−8.08, 38.17)	(−56.88, 16.25)	(1.34, 52.57)	(−6.50, 12.81)	(−7.36, 14.94)
	IRR	1.37	1.05	0.91	1.31	0.82	1.76	1.14	1.18
	95 % CI	(1.35, 1.40)	(0.81, 1.35)	(0.66, 1.26)	(0.87, 1.97)	(0.57, 1.17)	(1.02, 3.05)	(0.69, 1.87)	(0.77, 1.81)

[a]Late stage includes regional and distant stages.

Both males (IRR = 1.99, 95 % CI: 1.11, 3.59) and females (IRR = 1.99, 95 % CI: 1.16, 3.42) experienced their first significant relative rate increase between age groups 40–44 and 45–49. For females, this age group transition also had the steepest relative increase in CRC incidence and the largest absolute increase (IRD = 15.65, 95 % CI: 3.57, 27.73). The largest absolute increase for males was from age 50–54 to 55–59, with an IRD of 54.95 (95 % CI: 31.75, 78.15), and the steepest relative increase occurred in the same transition, with an IRR of 2.25 (95 % CI: 1.58, 3.20).

When stratified by stage, the steepest relative increase in the CRC rate occurred during the transition from the 40–44 to the 45–49 age groups for localized cases (IRR = 2.95, 95 % CI: 1.06, 8.19). For late-stage cases, the largest relative rate increase was observed between the 45–49 and 50–54 age groups (IRR = 2.02, 95 % CI: 1.19, 3.43). The largest absolute increase for localized-stage CRC was observed from age 50–54 to 55–59, with an IRD of 8.59 (95 % CI: 1.29, 15.88), and for late-stage at an earlier transition from age 45–49 to 50–54, with an IRD of 8.37 (95 %: 1.94, 14.80).

The IRDs were used to compare age-specific rates across different demographics: between males and females, between CHamorus and Filipinos, and between Guam and the United States. While not statistically significant, it is noteworthy that women in the 35–49 age group had slightly higher incidence rates than men of the same age. However, past the age of 50, men's rates increased rapidly, surpassing those for women (Fig. 1). In the 55–59 age group, the rate for men was 24.31 to 74.88 cases per 100,000 higher than that for women (P < 0.01).

Differences in age-specific incidence rates were observed across ethnic groups. Specifically, CHamorus had significantly higher rates compared to Filipinos in two age brackets. For the 45–49 age group, the rate difference was 19.53 per 100,000 (P = 0.04), while for the 55–59 age cohort, the difference was even larger at 77.93 per 100,000 (P < 0.01). Comparisons between Guam and the contiguous United States revealed significantly higher rates in the U.S. for those aged 50–54, with Guam experiencing 18.06 (95 % CI: −28.32, −7.80) fewer cases per 100,000. No significant differences between Guam and the U.S. were found in any other age group (Table 2).

3.3. Colorectal cancer screening uptake

Since the previously recommended starting age for CRC screening was 50, the BRFSS in 2018 limited inquiries regarding CRC screening behaviors to adults aged between 50 and 75 years. To better match BRFSS population sample with the age range of CRC incidence patients analyzed, we confined our BRFFS analysis to individuals aged 50 to 64. According to the 2018 BRFSS survey data, 34.3 % of adults within this age range reported having a colonoscopy in the past 10 years in Guam. When the age bracket was expanded to include adults up to 75 years, the screening prevalence in Guam slightly increased to 37.5 %. This rate was substantially lower than the median prevalence of 64.3 % reported across all U.S. states, the District of Columbia (DC), and other territories. In the same period, 4.5 % of adults aged 50–64 in Guam reported undergoing a stool test within the previous year—a rate comparable to that of adults aged 50–75. However, this was also much lower than the median rate of 8.9 % for adults aged 50–75 across all states, DC, and territories [25]. Colonoscopy rates were the lowest among individuals aged 50–54 years (26.3 %), individuals with less than a high school education (14.5 %), respondents with an annual income of less than $25,000 (24.1 %), and individuals without health insurance (19.4 %). Stool test rates were much lower than colonoscopy rates. Rates were the lowest among respondents aged 60–64 years (3.4 %), individuals with high school diplomas (4.6 %), respondents with an annual income between $25,000 and $50,000 (3.7 %), and individuals without health insurance (2.6 %). The prevalence of CRC screening varied substantially among ethnic groups; colonoscopy utilization ranged from 6.0 % for Micronesians to 55.9 % for White, and stool test rates ranged from 0 % for Micronesians to 9.9 % for Whites (Table 3).

3.4. Modifiable CRC risk factors comparison

In 2019, the Guam BRFSS survey included 2,426 respondents, 1,263 of whom were between the ages of 35–64. Among these participants, the largest group (38.3 %) consisted of CHamorus, followed by Filipinos at 26.1%. The average age of CHamoru participants was 51.26 years, while the average age for Filipinos was 50.12 years.

Compared to Filipinos, CHamorus reported smoking rates nearly two times as high (36.0 % vs. 19.0 %, P < 0.001), a rate of heavy drinking twice as high (10.5 % vs. 5.2 %, P < 0.001), and significantly higher rates of overweight or obesity (81.6 % vs. 57.4 %, P < 0.001). The prevalence of diabetes among CHamoru individuals was over twice as high as that among Filipinos, with rates of 21.9 % compared to 10.2 %, respectively. Interestingly, a significantly larger proportion of Filipinos (82.0 %) than CHamorus (79.9 %, P < 0.001) reported not adhering to BRFSS physical activity guidelines (Fig. 2).

4. Discussion

This study is the first investigation of EOCRC rates in Guam. The steepest relative increases in CRC incidence were observed between individuals aged 35–39 and 40–44 as well as between individuals aged 40–44 and 45–49, which are considered early-onset. In the United States, the highest increase occurs in the transition from the 45–49 to the 50–54 age group, likely due to screening-related diagnoses (Abualkhair et al., 2020 Jan 3). A significant portion (36.5 %) of EOCRC cases were diagnosed at a late stage, and this figure might be even higher considering 42.4 % of the cases were unstaged. The largest rate increase for late-stage cases was observed between the 45–49 and 50–54 age groups. While this sharp rise may largely represent heightened incidence due to screening detection, it also suggests cancers had been developing for

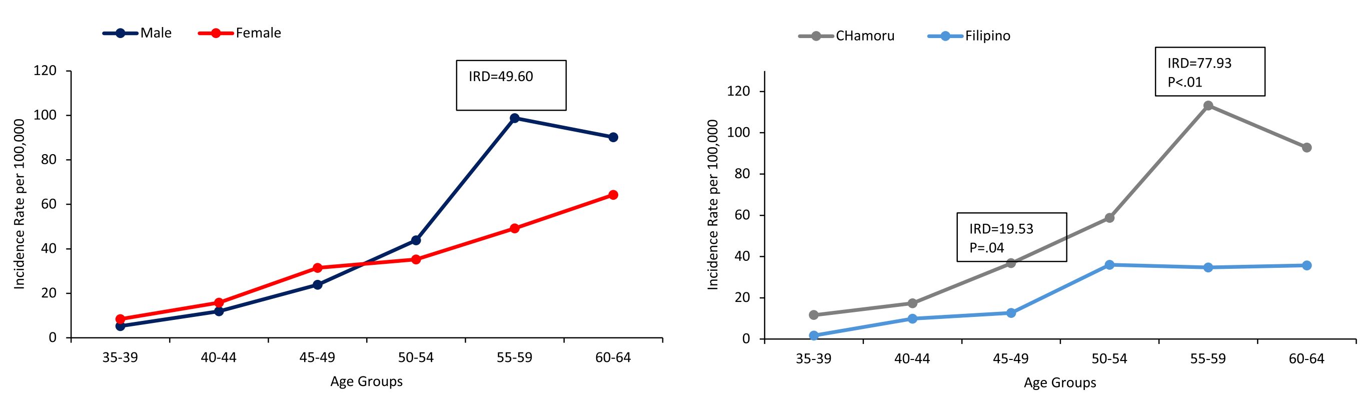

Fig. 1. Colorectal Cancer Age-Specific Incidence Rates per 100,000 Population Stratified by Ethnicity (CHamorus and Filipinos) and Sex (Males and Females) in Guam Cancer Registry Among Patients Aged 35–64 Years, 1998–2020.

Table 2
Age-specific colorectal cancer incidence rates comparison in guam cancer registry (1998–2020): Males vs. Females, CHamoru vs. Filipino, and Guam Cancer Registry (1998–2020) vs. US Surveillance, Epidemiology, and End Results 9 Registries (2000–2019) Among Patients Aged 35–64 Years.

	Male vs Female			CHamoru vs Filipino			GU vs US		
Age group	n	IRD (95 % CI)	P	n	IRD (95 % CI)	P	n	IRD (95 % CI)	P
35–39	18	−3.17 (−9.51, 3.17)	0.49	13	8.65 (−0.18, 17.48)	0.13	3333	−2.48 (−6.19, 1.23)	0.34
40–44	37	−3.82 (−12.73, 5.09)	0.56	25	6.39 (−4.92, 17.69)	0.43	6108	−3.31 (−8.28, 1.65)	0.34
45–49	70	−7.56 (−20.46, 5.33)	0.41	47	19.53 (3.83, 35.24)	0.04	10799	−2.84 (−9.63, 3.94)	0.57
50–54	84	8.65 (−8.33, 25.63)	0.48	68	25.95 (3.90, 48.00)	0.06	19718	−18.06 (−28.32, −7.80)	<0.01
55–59	131	49.60 (24.31, 74.88)	<0.01	95	77.93 (47.33, 108.53)	<0.01	20974	5.76 (−6.42, 17.93)	0.52
60–64	113	25.95 (−2.53, 54.43)	0.16	84	30.66 (−2.61, 63.94)	0.16	23660	−16.18 (−31.88, −0.48)	0.10

Table 3
Colorectal cancer screening rates (%) among adults aged 50–64, behavioral risk factor surveillance system Guam, 2018.

	Stool Test*	P-value	Colonoscopy**	P-value
Overall (n = 496)	**4.5**		**34.3**	
Age (Years)		<0.001		<0.001
50–54	5.1		26.3	
55–59	6.1		40.8	
60–64	3.4		39.3	
Gender		<0.001		<0.001
Male	6.3		36.2	
Female	3.4		32.3	
Education		<0.001		<0.001
Less than high school	2.3		14.5	
High school diploma	4.6		30.6	
Some college	5.1		35.0	
College graduate	7.2		55.4	
Income		<0.001		<0.001
Less than $25,000	2.4		24.1	
$25,000–$50,000	3.7		31.6	
More than $50,000	7.7		47.6	
Health Insurance		<0.001		<0.001
Yes	15.4		38.2	
No	2.6		19.4	
Ethnicity		<0.001		<0.001
CHamoru	4.9		34.9	
Filipino	5.6		33.3	
White	9.9		55.9	
Asian	3.7		48.3	
Micronesian	0.0		6.0	

*in the past year, **in the past 10 years.

several years prior to reaching age 50, implying a delay in diagnosis. There were also significant differences in the incidence rates of EOCRC between sex and ethnic groups. Women younger than 50 years old had higher rates than men, and at age 50, the rates crossed over. Steep increases in rates occurred before the age of 50 years for CHamorus and women.

In Guam, prevalence of CRC risk factors and the associated burden differed significantly across ethnic groups. The CHamoru population exhibited a greater prevalence of significant CRC risk factors such as cigarette smoking, obesity, diabetes, and alcohol consumption compared to Filipinos. This elevated prevalence may contribute to the higher CRC incidence rates observed among CHamorus. The rise in obesity rates in this group likely indicates an adoption of a Westernized diet and lifestyle (Novotny et al., 2022). Addressing these concerns might require a mix of healthcare and community-based interventions, along with policy shifts that encourage healthy habits and guarantee access to optimal CRC prevention, diagnosis, and treatment. Culturally tailored health interventions can potentially reduce the CRC burden in the CHamoru population.

This study presents some limitations, including an ecological design that inherently restricts the scope of inference. Another constraint is the very small sample size, despite incorporating all CRC cases from the Guam Cancer Registry over a span of 23 years, which is a limitation imposed by the small size of the target population. However, the study has important strengths. This study evaluates a population frequently underrepresented in cancer surveillance literature and provides a comprehensive compilation of all available CRC data for this population over a 23-year period. Additionally, through examining the prevalence and disparities in CRC risk factors and screening rates among Guam's different ethnic groups, this study presents current information that is not possible with aggregated CDC data. Evidence suggests that population screening can significantly reduce both the incidence and mortality of CRC (U.S. Preventive Services Task Force, 2021). Yet, CRC screening rates in Guam remain low, especially when compared to those in the U.S. The CRC mortality in Guam is higher than in the U.S. (17.3 vs 14.2 respectively, 2013–2017 data). While CRC mortality rates in the U.S. are decreasing for both sexes, Guam's rates have remained relatively unchanged since 1998: about 22 per 100,000 for males and 14.5 per 100,000 for females. In addition, there are significant ethnic disparities, with mortality rates among CHamorus 1.6 times higher than mortality among Filipinos (Lee et al., 2022).

Future research should focus on identifying etiological genetic and environmental/behavioral risk factors and predictors for EOCRC specific to Guam's ethnic populations. It is also crucial to investigate why EOCRC rates are comparable between males and females at younger ages but diverge significantly as age increases. Additionally, exploring barriers to screening, including healthcare access and perceptions of racial or ethnic medical discrimination, can inform intervention strategies tailored to Guam's demographic characteristics.

5. Conclusion

In Guam, steep increases in CRC incidence were observed between the 35–39 and 40–44 age groups and between the 40–44 and 45–49 age groups. Rate increases occurred at younger ages in CHamorus compared to Filipinos, with higher rates of EOCRC observed in CHamorus and the Guam population under 50 years. CRC screening prevalence and associated risk factors varied across ethnic groups. These findings support the updated recommended screening guidelines in individuals younger than 50 and efforts to increase screening uptake in Guam, which remains low compared to U.S. screening rates.

CRediT authorship contribution statement

Grazyna Badowski: Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Conceptualization. **Rodney Teria:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation. **Michelle Nagata:** Writing – review & editing, Writing – original draft. **Justin Legaspi:** Writing – review & editing, Writing – original draft. **Louis Jane B. Dulana:** Formal analysis, Conceptualization. **Renata Bordallo:** Writing – review & editing, Writing – original draft, Data curation. **Brenda Y. Hernandez:** Writing – review & editing, Writing – original draft.

Declaration of competing interest

The authors declare that they have no known competing financial

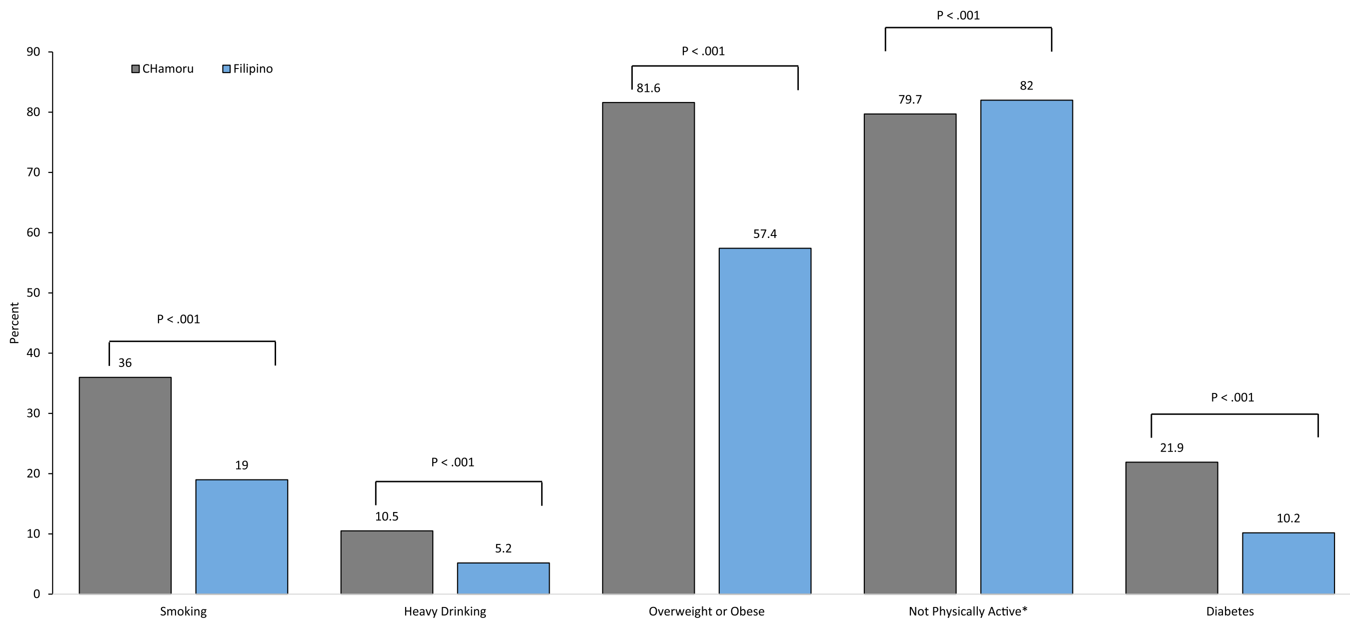

Fig. 2. Prevalence Rates (%) of CRC Cancer Risk Factors Among Adults Aged 35–64 Stratified by Ethnicity, Behavioral Risk Factor Surveillance System Data, Guam 2019. P-values based on Chi-Square Test. (* Did not meet physical activity guidelines).

interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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