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Colorectal cancer screening among Hispanics in the United States: Disparities, modalities, predictors, and regional variation

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ABSTRACT

Hispanics represent the largest and one of the fastest growing minority populations in the U.S. and have lower survival from colorectal cancer (CRC) than non-Hispanic Whites (NHW). We aimed to examine screening modalities, predictors, and regional disparities among Hispanics and NHW in the U.S. by conducting a cross-sectional analysis of Hispanic participants age 50 to 75 from the 2016 Behavioral Risk Factor Surveillance System (BRFSS) survey. The primary outcome was self-reported CRC screening status. We used the Rao-Scott Chi-square test to compare screening rates and modalities in NHWs and Hispanics. We also used univariable and multivariable logistic regression to determine predictors of screening among Hispanics and calculated Hispanic-NHW screening rate differences for each U.S. state/territory as a measure of regional screening disparities. The screening rate was 53.4% for Hispanics (N = 12,395), compared to 70.4% for NHWs (N = 186,331) ($p < 0.001$). Among Hispanics, colonoscopy was most common (75.9%). Uninsured status (aOR = 0.51; 95% CI = 0.38–0.70) and limited access to medical care (aOR = 0.38; 95% CI = 0.29–0.49) predicted lack of screening. States/territories with the largest screening disparities were North Carolina (33.9%), Texas (28.3%), California (25.1%), and Nebraska (25.6%). Disparities were smallest in New York (2.6%), Indiana (3.1%), and Delaware (4.0%). In Ohio and Guam, Hispanics had higher screening rates than NHWs. In conclusion, Hispanics have lower CRC screening rates than NHWs across most U.S. states/territories; however, the disparity varies by region. Future efforts must address multi-level barriers to screening among Hispanics and target regions with low rates to improve CRC outcomes in this growing population.

1. Introduction

Colorectal cancer (CRC) is a common and deadly malignancy among men and women in the United States (U.S.) (Siegel et al., 2017). Several studies demonstrate that screening for CRC decreases incidence and mortality, and the initiation of screening programs in the U.S. has improved CRC outcomes (Mandel et al., 1999; Hardcastle et al., 1996; Shaukat et al., 2013; Kronborg et al., 1996; Atkin et al., 2010; Segnan et al., 2011; Nishihara et al., 2013; Schoen et al., 2012; Yang et al., 2014). As a result, many national organizations, including the United States Preventive Services Task Force (USPSTF), recommend CRC screening for all average-risk adults between the ages 50 and 75

Abbreviations: CRC, colorectal cancer; U.S., United States; FIT, fecal immunochemical test; FOBT, fecal occult blood test; FS, flexible sigmoidoscopy; NCCRT, National Colorectal Roundtable; BRFSS, Behavioral Risk Factor Surveillance System; NHW, non-Hispanic White; CDC, Centers for Disease Control and Prevention; USPSTF, United States Preventive Services Task Force; DDS, Disproportionate stratified sample; AIC, Akaike Information Criterion; FQHC, Federally Qualified Health Centers

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Table 1
Descriptive statistics of the study population, Hispanics, N = 12,395.

Characteristic	Screened n (%)[a]	Unscreened n (%)[b]	Total n (%)[c]	p value
Age				
50–54	1272 (38.8)	1760 (61.2)	3032 (30.1)	< 0.001
55–59	1550 (49.5)	1194 (50.5)	2744 (23.4)	
60–64	1642 (59.1)	921 (40.9)	2563 (21.9)	
65–69	1581 (69.8)	644 (30.2)	2225 (13.7)	
70–75	1337 (70.3)	494 (29.7)	1831 (10.8)	
Sex				
Male	2853 (49.4)	2223 (50.6)	5076 (47.9)	< 0.001
Female	4529(57.0)	2789 (43.0)	7318 (52.1)	
Language				
English	4241 (60.9)	2281 (39.1)	6522 (45.2)	< 0.001
Spanish	3132 (47.2)	2726 (52.8)	5858 (54.8)	
Other	9 (59.2)	6 (40.8)	15 (0.03)	
Marital status				
Married	4165 (55.0)	2561 (45.0)	6726 (58.0)	0.04
Not married	3193 (51.3)	2426 (48.7)	5619 (42.0)	
Education				
Did not graduate from high school	1641 (45.5)	1801 (54.5)	3442 (44.2)	< 0.001
High school graduate/GED	1879 (57.9)	1276 (42.1)	3155 (22.1)	
Some college	2059 (58.3)	958 (41.7)	2738 (21.1)	
College degree or higher	2059 (65.5)	958 (34.5)	3017 (12.7)	
Employment				
Employed	2700 (45.3)	2486 (54.7)	5186 (46.4)	< 0.001
Unemployed or student	2175 (55.0)	1611 (45.0)	3786 (33.1)	
Retired	2476 (70.0)	875 (30.0)	3351 (20.5)	
Annual household income ($)				
$0–$24,999	2964 (49.2)	2457 (50.8)	5421 (52.1)	< 0.001
$25,000–$49,999	1416 (54.0)	972 (46.0)	2388 (25.0)	
$50,000–$74,999	702 (58.9)	328 (41.1)	1030 (8.7)	
$75,000 +	1183 (63.8)	458 (36.2)	1641 (14.2)	
Health insurance coverage				
Yes	6950 (58.6)	3924 (41.4)	10,874 (83.1)	< 0.001
No	413 (27.6)	1071 (72.4)	1484 (16.9)	
Access to a health care provider				
Yes	6776 (60.8)	3584 (39.2)	10,360 (79.2)	< 0.001
No	587 (25.5)	1403 (74.5)	1990 (20.8)	
Self-reported health status				
Excellent/very good	2188 (53.1)	1427 (46.9)	3615 (25.6)	0.14
Good	2359 (51.2)	1689 (48.8)	4048 (32.8)	
Fair/poor	2806 (55.4)	1868 (44.6)	4674 (41.6)	
All respondents	7382 (53.4)	5013 (46.6)	12,395 (100.0)	< 0.001

Results reported as unweighted n (wt%).
P-Values represent results of Rao-Scott Chi-square tests comparing weighted screening rates by participant characteristics.
[a] Screened % denotes the weighted percentage of individuals in each subgroup who received CRC screening.
[b] Unscreened % denotes the weighted percentage of individuals in each subgroup who did not receive CRC screening.
[c] The percentages in this column reflect the weighted proportions of individuals within each category. Total number in each category might not add up to 12,395 due to missing values.

(Bibbins-Domingo et al., 2016; Ransohoff and Sox, 2016). Screening options include colonoscopy every 10 years, fecal immunochemical test (FIT) or fecal occult blood test (FOBT) every year, stool-DNA every 3 years, and flexible sigmoidoscopy (FS) every 5 years with FIT every year (Bibbins-Domingo et al., 2016). Despite universal guidelines and strong evidence for the benefits of screening, the overall CRC screening rate in the U.S. is only 63%—far below the *HealthyPeople 2020* goal of 70.5% and the National Colorectal Roundtable (NCCRT) goal of 80% for the U.S. population (American Cancer Society, 2017).

Currently, Hispanics are the largest and one of the fastest growing minority populations in the U.S. (United States Census Bureau, 2019a; United States Census Bureau, 2019b). While CRC incidence and mortality have decreased in all racial and ethnic groups over the past two decades, the decline has been less notable for Hispanics (Ashktorab et al., 2017; Ellis et al., 2018; Garcia et al., 2018). Mortality from CRC dropped by 15.1% among non-Hispanic Whites from 2000 to 2011 but by only 5.9% among Hispanics (Barzi et al., 2017). Currently CRC is the second most common malignancy among Hispanics in the U.S., and low CRC screening rates in this group contribute to poor outcomes (American Cancer Society, 2017; May et al., 2019; Pollack et al., 2006; Gonzales et al., 2012; Singh and Jemal, 2017). In 2015, 47.4% of Hispanics were up-to-date with CRC screening, compared to 63.7% of Whites (White et al., 2017).

In the general U.S. population, factors associated with CRC screening uptake include age, health care access, nativity, level of education, language, socioeconomic factors, insurance status, overall health, and provider practices (American Cancer Society, 2017; Ellis et al., 2018; Singh and Jemal, 2017; Walter et al., 2009; Suzuki et al., 2015; Buscemi et al., 2017; Stanley et al., 2013). While several studies have explored the relative contribution of these factors to screening uptake at the population-level, fewer have explored the role of factors that impact CRC screening uptake among Hispanics specifically. There

Table 2
CRC screening modalities by race/ethnicity and language.

Modality	NHW (All languages) N (%)	Hispanics (All languages) N (%)	Hispanics (English) N (%)	Hispanics (Spanish) N (%)	p value[1]	p value[2]
Colonoscopy only[a]	117,538 (85.7)	5790 (75.9)	3517 (82.0)	2266 (69.3)	< 0.0001	< 0.001
FOBT or FIT only[b]	5985 (5.2)	633 (11.0)	276 (6.5)	356 (15.8)	< 0.0001	< 0.001
FS + FOBT or FIT only[c]	641 (0.6)	57 (1.1)	29 (1.3)	28 (0.8)	0.005	0.232
More than one method[d]	10,501 (8.4)	866 (11.3)	401 (9.8)	464 (12.9)	< 0.0001	< 0.05
Unknown[e]	221 (0.1)	36 (0.7)	18 (0.3)	18 (1.1)	–	–
Total	134,886 (100.0)	7382 (100.0)	4241(100.0)	3132 (100.0)		

CRC colorectal cancer, FOBT fecal occult blood testing, FIT fecal immunochemical testing, FS flexible sigmoidoscopy, NHW non-Hispanic Whites.
Results reported as unweighted N (wt%).

[a] Colonoscopy screening occurred over the last 10 years.

[b] FOBT or FIT screening occurred over the last 1 year.

[c] Flexible sigmoidoscopy screening occurred over the last 5 years plus FOBT/FIT over the last 3 years.

[d] "More than one method" includes colonoscopy over the last 10 years and FOBT/FIT over the last 1 year.

[e] Unknown modality denotes subjects who had FOBT/FIT in the past three years and either sigmoidoscopy or colonoscopy in the past five years due to unavailable information regarding which exam was utilized.

[1] p value was derived from the chi-square test comparing utilization of each screening modality between NHW and Hispanics without regard to language.

[2] p value was derived from the chi-square test comparing utilization of each screening modality between the English-speaking Hispanic and Spanish-speaking Hispanics.

is also a lack of data about regional differences in screening uptake between Hispanics and Whites and about the most common screening modalities used by Hispanics—information that can guide efforts to increase screening uptake and improve CRC outcomes among Hispanics. Thus, we aimed to achieve four objectives in this study: 1) to compare CRC screening rates in Hispanics and Whites in the U.S., 2) to compare screening modalities used by Hispanics and Whites, 3) to determine predictors of screening among U.S. Hispanics, and 4) to quantify regional (state-level) variation in CRC screening rates among Hispanics in the U.S.

2. Methods

2.1. Data source and study population

We used data from the Centers for Disease Control and Prevention (CDC) 2016 Behavioral Risk Factor Surveillance System (BRFSS) survey. BRFSS is a cross-sectional standardized telephone survey (landline and cellular) that is administered annually in all 50 states, the District of Columbia, and three U.S. territories (Guam, Puerto Rico, and U.S. Virgin Islands). The survey collects data from 400,000 adults on demographic factors, health behaviors, disease prevalence, and utilization of preventive health services. The BRFSS survey response rate is modest (47.0%) and ranges from 30.7% to 65.0% for included states. BRFSS utilizes complex sampling and weighting methods to accurately represent the population in each state and ensure accurate estimates for the entire U.S. population (Centers for Disease Control and Prevention (CDC), n.d.).

Every two years the BRFSS survey includes questions about CRC screening and provides CRC screening data for all states/territories. Our study population includes all 2016 BRFSS participants self-identified as "Hispanic, Latino/a, or Spanish origin" and between the ages of 50 and 75 years who completed the CRC screening module. For the purpose of comparing CRC screening rates, we also identified non-Hispanic White (NHW) BRFSS 2016 participants between the ages 50 and 75 that completed the CRC screening module.

2.2. Measures

The primary outcome was self-reported completion of CRC screening. Participants were asked if they had ever completed a stool blood test (FOBT or FIT), colonoscopy, and sigmoidoscopy as individual questions. Those who reported having any of these tests/exams were then asked how long it had been since the last test/exam and given several options (1, 2, 3, 5, 10, or more years). In accordance with the 2008 USPSTF CRC screening guidelines relevant at the time of the survey, we considered those who had a stool blood test within the past one year, colonoscopy within the past ten years, or flexible sigmoidoscopy within the past five years plus stool blood test within the past three years "screened" (Calonge et al., 2008). Those who did not meet any of these criteria were considered "unscreened".

We created five categories for screening modality. Apart from the three aforementioned methods recommended by USPSTF, we created a fourth category called "screened more than once or by more than one method" for participants who reported having two or more of FIT/FOBT in the past year, flexible sigmoidoscopy in the past five years, or colonoscopy in the past ten years. Participants who reported screening uptake in the past five years but did not report the specific test/type of exam were classified as "unknown" (i.e. affirmed "sigmoidoscopy or colonoscopy within 5 years" but did not answer secondary question about which was performed). We used analytic code for CRC screening and modalities provided by BRFSS (National Center for Chronic Disease Prevention and Health Promotion, Division of Population Health, 2014).

Covariates included participant sociodemographic and health factors. Sociodemographic factors were age (50–54, 55–59, 60–64, 65–69, 70–75 years), gender, marital status, highest level of education (less than high school, high school/GED, some college or college, and beyond), employment status (employed, unemployed/student, or retired), annual household income (< $25,000, $25–49,999, $50–74,999, or ≥$75,000), and primary language (English, Spanish, or other). Health factors were health insurance status, access to at least one health care provider (designated personal healthcare provider), and self-reported health status (excellent/very good, good, or fair/poor). Primary language is designated by BRFSS as the questionnaire language used to administer survey items (Centers for Disease Control and Prevention (CDC), n.d.).

2.3. Statistical analyses

We used survey weights to summarize sociodemographic factors, health characteristics, and CRC screening uptake for the study population. We then used the Rao-Scott Chi-square test to compare demographics between those who did and did not complete screening and to compare the weighted proportion of screened participants that utilized each screening modality. Screening uptake and modalities were also

Table 3
Bivariate and multivariable analyses of factors associated with CRC screening among Hispanics, N = 12,395.

Variable	Unadjusted OR (95% CI)	Adjusted OR[a] (95% CI)
Age		
50–54	0.27 (0.21–0.34)	0.33 (0.24–0.45)
55–59	0.41 (0.32–0.54)	0.48 (0.35–0.66)
60–64	0.61 (0.47–0.79)	0.72 (0.52–0.99)
65–69	0.98 (0.74–1.28)	0.96 (0.69–1.32)
70–75	Reference	Reference
Sex		
Male	Reference	Reference
Female	1.36 (1.18–1.57)	1.25 (1.05–1.80)
Language		
English	Reference	Reference
Spanish	0.57 (0.50–0.66)	0.84 (0.69–1.02)
Other	0.93 (0.24–3.56)	–
Marital status		
Married	1.16 (1.01–1.34)	1.08 (0.90–1.29)
Not married	Reference	Reference
Education		
Did not graduate from high school	0.44 (0.36–0.53)	0.53 (0.41–0.69)
High school graduate/GED	0.72 (0.60–0.88)	0.76 (0.60–0.97)
Some college	0.74 (0.60–0.91)	0.68 (0.54–0.86)
College degree or higher	Reference	Reference
Employment		
Employed	Reference	Reference
Unemployed or student	1.47 (1.25–1.74)	1.45 (1.17–1.80)
Retired	2.82 (2.32–3.42)	1.32 (1.02–1.71)
Annual household income ($)		
$0–$24,999	0.55 (0.43–0.70)	0.61 (0.45–0.84)
$25,000–$49,999	0.67 (0.51–0.88)	0.88 (0.65–1.20)
$50,000–$74,999	0.81 (0.57–1.15)	0.80 (0.56–1.14)
$75,000 +	Reference	Reference
Health insurance coverage		
Yes	Reference	Reference
No	0.27 (0.21–0.34)	0.51 (0.38–0.70)
Access to a health care provider		
Yes	Reference	Reference
No	0.22 (0.18–0.27)	0.38 (0.29–0.49)
Self-reported health status		
Excellent/very good	Reference	Reference
Good	0.93 (0.77–1.12)	1.24 (1.01–1.54)
Fair/poor	1.10 (0.92–1.31)	1.42 (1.12–1.80)

OR odds ratio, CI confidence interval.

[a] Adjusted odds ratios were estimated by building a multivariable logistic regression model including all covariates as independent variables. The final model (model 5) had the highest adjusted R^2 and lowest Akaike Information Criterion (AIC) of five models that included different sets of independent variables.

stratified by ethnicity (Hispanic and NHW) and preferred language (Spanish-speaking and English-speaking).

We examined the crude association between each covariate and the binary outcome by utilizing univariate logistic regression models. We then created a series of multivariable logistic regression models that included different sets of independent variables: (1) only demographic variables (age, gender, language, marital status); (2) demographic variables and socioeconomic variables (educational attainment, employment status, household income); (3) demographic variables and health related variables (self-reported health status, health insurance coverage, access to health provider); (4) all variables that had a statistically significant ($p < 0.05$) crude association with the outcome; and (5) all available variables. We calculated an adjusted R^2 and Akaike Information Criterion (AIC) for each model and selected as our final model the model with the highest adjusted R^2 and the lowest AIC (Afifi et al., 2012).

To evaluate variation in Hispanic-NHW screening disparities across U.S. states/territories, we compared the screening rate for Hispanics and for NHWs in each U.S. state/territory included in BRFSS. We did not report state/territory percentage estimates where the relative standard error was > 30% or the denominator represented fewer than 50 respondents from an unweighted sample (Ingram et al., 2018). All statistical analyses were performed with SAS (Version 9.4, Cary NC) and incorporated individual weight, strata, and cluster variables to account for the complex sampling design. A p-value < .05 was considered statistically significant.

3. Results

3.1. Study population and CRC screening uptake

The study cohort included 12,395 Hispanic participants and 186,331 NHWs. The majority of Hispanics were 50–59 years of age (53.5%), and 52.1% were female. Over half (54.8%) were Spanish-speakers, 46.4% were employed, 83.1% had health insurance, and 66.3% had a high school degree or less (Table 1).

Overall, 53.4% of Hispanic participants (95% CI = 52.7–55.1) were up to date with CRC screening in 2016. This rate was statistically lower than the screening rate for NHWs (N = 186,331) in the same year (70.4%; 95% CI = 70.0–70.9). In bivariate analyses, CRC screening rates among Hispanics increased as age, education, and income increased (Table 1). Rates were higher among females than males (57.0% vs. 49.4%, $p < 0.001$), the insured compared to the uninsured (58.6% vs. 27.6%, $p < 0.001$), and English-speaking Hispanics compared to Spanish-speaking Hispanics (60.9% vs. 47.2%, $p < 0.001$) (Table 1).

3.2. CRC screening modalities

Among Hispanics, colonoscopy was the most common screening modality (75.9%), followed by FOBT/FIT (11.0%), and FS with FOBT/FIT (1.1%) (Table 2). Among NHWs, colonoscopy was also the most common modality (85.7%); NHWs were more likely to undergo colonoscopy than Hispanics ($p < 0.0001$). 11.3% of Hispanics reported use of 2 or more modalities.

There were key differences in screening modalities by language, with English-speaking Hispanics reporting significantly higher colonoscopy rates than Spanish-speaking Hispanics (82.0% vs. 69.3%, $p < 0.001$). Spanish-speaking Hispanics reported higher FOBT/FIT rates (15.8% vs. 6.5%, $p < 0.001$) and higher incidence of 2 or more modalities (12.9% vs. 9.8%, $p < 0.05$) than English-speaking Hispanics. There were no significant differences between these two language groups in the use of FS with FOBT/FIT (Table 2). Overall, patterns of screening modality were similar among English-speaking Hispanics and NHWs.

3.3. Predictors of CRC screening

Table 3 provides the unadjusted and adjusted logistic regression results for predictors of CRC screening among Hispanics. Model 5 (all variables) was selected based on highest adjusted R^2 and lowest AIC. In the adjusted model, female gender (adj. OR for female vs. male: 1.25, 95% CI = 1.05–1.48) was a significant predictor of screening uptake. Retired status (adj. OR 1.32, 95% CI = 1.02–1.71) and unemployed status (adj. OR 1.45, 95% CI = 1.17–1.80) were associated with higher odds of screening than employed status. We also found that poor/fair health status was associated with higher screening uptake than excellent/very good health (adj. OR 1.42; 95% CI = 1.12–1.80).

Significant predictors of lack of screening included younger age (age 50–54 vs. 70–75: adj. OR 0.33, 95% Cl = 0.24–0.45), lack of insurance (adj. OR = 0.51, 95% CI = 0.38–0.70) and limited access to a health care provider (adj. OR = 0.38, 95% CI = 0.29–0.49). Those without a

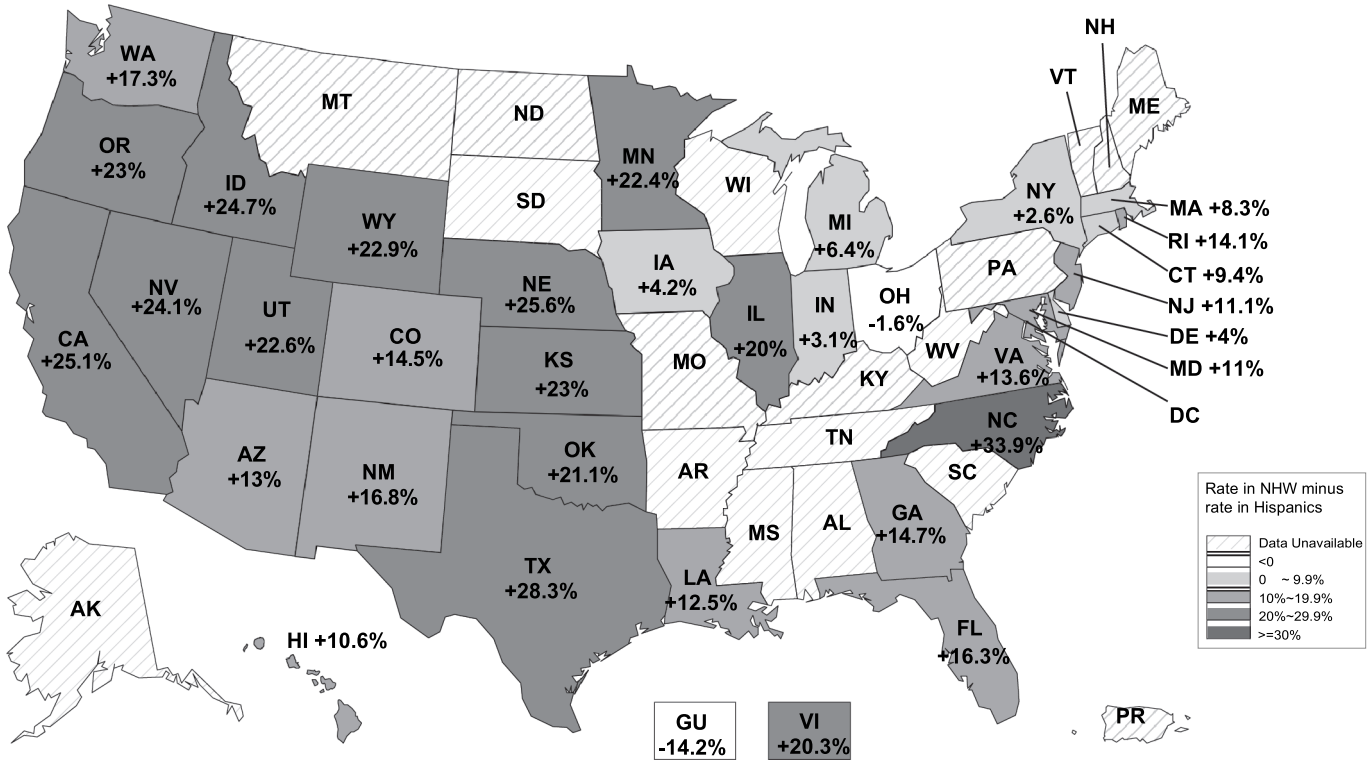

Fig. 1. Hispanic-NHW Disparities in CRC screening rates by U.S. state/territory.
GU Guam, VI Virgin Islands, PR Puerto Rico.
% denotes the difference in CRC screening rate between NHWs and Hispanics for each U.S. state/territory. A positive value denotes a higher CRC screening rate among NHWs. A negative value denotes a higher CRC screening rate among Hispanics.

high school degree had 47% lower odds of screening than those with a college degree (adj. OR = 0.53, 95% CI = 0.41–0.69), while those earning less than $25,000 annually had 39% lower odds than those with over $75,000 in income annually (adj. OR = 0.61, 95% CI = 0.45–0.84). Language was not a significant predictor of screening status in adjusted models (adj. OR 0.84, 95% CI = 0.69–1.02). Of note, among NHWs, there were many similarities in significant associations between these factors and CRC screening uptake (Supplement Table).

3.4. CRC screening disparities by state

The screening disparity between NHWs and Hispanics ranged from −14.2% to 33.9% across the states/territories included, where a positive value denotes a higher CRC screening among NHWs, and a negative value indicates higher rates in Hispanics (Fig. 1). North Carolina had the highest disparity at 33.9%. States/territories with the next greatest disparities were Texas (28.3%), Nebraska (25.6%), and California (25.1%). The states/territories with the most narrow disparities were New York (2.6%), Indiana (3.1%), and Delaware (4.0%). The only two states/territories in which CRC screening rates were higher in Hispanics than NHWs were Ohio (−1.6%) and Guam (−14.2%) (Fig. 1).

4. Discussion

We used the largest national health survey to demonstrate low CRC screening rates among Hispanics and regional variation in screening disparities in the U.S. We also highlight lower colonoscopy utilization among Hispanics compared to NHWs and several predictors of screening uptake among Hispanics. Our findings suggest that there are geographic differences in screening uptake for Hispanics in the U.S. and support the need for widespread efforts to address screening disparities. Our results are consistent with findings in the literature and support that although CRC screening rates among Hispanics have increased since 2002 (41.9%) and 2006 (47%), there are persistent gaps when compared to rates among NHW (55.2% and 60%, respectively for those BRFSS survey years) (Pollack et al., 2006; Gonzales et al., 2012; Mojica et al., 2017; Ilunga Tshiswaka et al., 2017).

Low CRC screening rates among Hispanics are likely due to multiple patient-, provider-, system-, and state-level factors. In our study, female gender was associated with higher screening rates among Hispanics, consistent with other racial/ethnic groups and with themes from qualitative studies that maintenance of masculinity, embarrassment about invasive procedures, and fear are possible contributors to low screening rates among Hispanic males (Ek, 2015; Hernandez et al., 2018; Thompson et al., 2016; Timothy et al., 1996; Leal et al., 2018). Previously published studies support our findings that Hispanics with high educational attainment, high income, health insurance, and access to a healthcare provider have higher odds of up-to-date screening (Byrd et al., 2019; Goodman et al., 2006; Ojinnaka et al., 2015). While English language preference was associated with higher screening uptake in bivariate comparisons, language did not emerge as a significant predictor of screening uptake in multivariable models in our study, likely due to inter-correlations with other significant predictors such as education and income. In addition, Hispanics who were employed or who reported excellent/good health were less likely to be up-to-date with screening. A possible explanation for these findings is that Hispanics who report excellent or good health may be less likely to pursue healthcare in general or to prioritize preventive services. Hispanics who are employed may be employed by employers that do no provide or promote use of health services or that do not offer time away from work to participate in health visits and preventive services (Ross et al., 2007). According to U.S. Census Bureau data, Hispanics have lower rates of employer-based insurance than NHWs (Berchick et al., 2017). Thus, despite being employed, Hispanics may not have access to employer-

based insurance and access to healthcare services such as CRC screening. Moreover, lower colonoscopy utilization among Hispanics than NHWs might reflect screening test preferences, cultural preferences, health system practices, and/or access to colonoscopy (Sauer et al., 2017; Singal et al., 2017). Settings like Federally Qualified Health Centers (FQHC) that see a high proportion of Hispanic patients often exclusively use lower cost and highly accessible CRC screening options like FOBT and/or FIT (Domingo and Braun, 2017).

Hispanic-NHW screening disparities varied by state/territory. We found that differences in screening rates between Hispanics and NHWs were greatest in North Carolina and Texas. Guam and Ohio were the only two states/territories in which screening rates were higher in Hispanics than NHWs. The variation observed is likely multifactorial with roles of state-level health policy, health insurance patterns, state demographics, and other factors. There is wide variation in state-level policies that impact insurance coverage and access to preventive services like screening. States that underwent Medicaid expansion or with similar insurance rates among Whites and Hispanics had smaller Hispanic-White screening disparities. Nineteen U.S. states (11 in our analyses) had not undergone Medicaid expansion under the Affordable Care Act (ACA) in 2016 (Kaiser Family Foundation, 2019). Eight out of these 11 states had a > 20% CRC screening rate difference between Hispanics and NHWs in our analyses. There were also 9 states/territories (Guam, Ohio, New York, Indiana, Delaware, Iowa, Michigan, Massachusetts, Connecticut) with a < 10% screening disparity, all of which underwent Medicaid expansion (Kaiser Family Foundation, 2019). Supporting this observation, states with larger CRC screening disparities (Texas, Nebraska, California, Idaho, Nevada, Kansas, Oregon, Wyoming, Utah, Minnesota) had 9.2%–23.9% lower insurance coverage among Hispanics than NHWs in BRFSS data. In the 10 states with the lowest screening disparities, the Hispanic-NHW insurance rate differences were < 10%.

In addition to these factors, disparities are also likely influenced by the size of the state (i.e. the screening rate in Massachusetts was 8.3% higher in NHWs than Hispanics while it was 28.3% higher in NHWs in Texas); overall screening rate in the state (i.e. the overall screening rate in New York is higher than in California, but the screening disparity is lower); the predominant Hispanic origin in each state (i.e. rates are lower in Mexican-Hispanics than in Puerto Rican Hispanics); immigration rates; and acculturation (American Cancer Society, 2017; Miller et al., 2018; Byrd, 1990). Furthermore, many states/territories with smaller Hispanic populations had smaller Hispanic-NHW screening disparities. Hispanics are a very small proportion of the population in Ohio (3.8%) and Guam (0.8%) where there were no disparities in screening (United States Census Bureau, 2019b). When minority populations are large and siloed, it may be increasingly difficult to maintain equitable distribution of health information and health services. There is a need for future research to further elucidate the relative contribution of these state-level factors on screening rate differences.

Our study is not without limitations. First, there is a potential for selection bias, which we feel is minimal given BRFSS's unique, randomized complex sampling design and application of survey weights. Second, self-reported data introduces a potential for recall bias as survey participants may not recall participation in screening and dates of screening accurately. Yet, our analyses compare Hispanics to NHWs, and there is no reason to suspect that recall bias is different for these two groups. Another limitation of the BRFSS survey is that respondents do not differentiate between test use for screening and diagnostic purposes; however, the indication for FOBT/FIT is CRC screening, and the majority of colonoscopies in the U.S. are screening exams (Joseph et al., 2016). The BRFSS 2016 survey was unable to report CRC screening rates among Hispanics for 17 states and the District of Columbia due to sparse data and imprecise estimates for Hispanics. Many of the excluded states/territories are in the South and Midwest, which limits our ability to comment on how screening rates and disparities vary in these regions. Nonetheless, BRFSS provides the most detailed CRC screening data on Hispanics nationally. While our assessment does not include every state/territory, it does highlight that screening rates among Hispanics are suboptimal overall and that there is broad variation. It will be beneficial for the CDC to survey a larger sample in these states/territories in the future so that we can better understand the full scope of regional variation in CRC screening disparities and assure that we are prioritizing interventions in states/territories with the greatest disparities. Lastly, as BRFSS does not collect data on origin of Hispanic survey participants, we are unable to provide details on how screening rates vary by Hispanic subgroup (i.e. Mexican-Hispanics, Puerto Rican Hispanics), which deserves further research focus.

Even considering these limitations, our study has several major strengths. First, we used a large and diverse national database with information about health characteristics and health practices to answer novel questions about CRC screening in Hispanics. At a time when there is much public health attention on suboptimal screening rates in the U.S. overall, it is important to also evaluate inequities and understand contributors to disparities in this large and growing population. Second, our study highlights differences in screening modalities by ethnicity and language. English-speaking Hispanics appeared to utilize screening modalities more similar to NHWs than Spanish-speaking Hispanics, which may reflect similarities in factors like income, education, insurance, and access to health information. Future work will help determine if differences in colonoscopy and stool-based screening test utilization reflect differences in individual preferences or healthcare settings between Spanish-speaking Hispanics and NHWs and inform interventions to increase uptake of screening. Lastly, we quantify the screening disparity for each U.S. state and territory included in BRFSS, which will help direct future efforts to improve screening rates among Hispanics. While states like California and Texas will need aggressive interventions to close the screening rate gap between NHWs and Hispanics, Ohio and Guam will benefit most from efforts to maintain high screening uptake among Hispanics. Furthermore, best practices in states with small or no screening disparities might inform strategies to increase screening rates among Hispanics in states with large disparities. BRFSS is one of the few data sources that allows us to perform regional analyses, and our findings reflect available national data.

In conclusion, our study provides valuable information for patients, healthcare providers, researchers, and health policy makers. Patients will benefit from increased knowledge about Hispanic-NHW CRC screening disparities in the U.S. and from interventions informed by this and similar studies. Healthcare providers must have heightened awareness about low screening rates among Hispanics, especially Spanish-speaking Hispanics, and recognize barriers to screening in this population subgroup. Those involved in research and health policy must consider tailored interventions that are culturally, linguistically, structurally, and geographically appropriate for Hispanic communities and that address patient-, provider-, and system-level barriers to CRC screening. In addition, interventions that consider or experiment with regional factors, state-level policies, FQHC settings, patient-preferred screening modalities, employee-based preventive service options, and/or state-level policies may result in the highest gain. A focus on improving CRC screening in the largest minority group in our nation has the potential to drive down incidence and mortality from CRC and improve survivorship overall.

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Declaration of competing interest

The authors have no conflicts of interest to disclose.

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