



Published in final edited form as:

Clin Gastroenterol Hepatol. 2015 August ; 13(8): 1487–1495. doi:10.1016/j.cgh.2015.02.038.

Racial and Ethnic Disparities in Colonoscopic Examination of Individuals With a Family History of Colorectal Cancer

Christopher V. Almario, MD^{1,2}, Folasade P. May, MD, MPhil^{1,2}, Ninez A. Ponce, MPP, PhD^{3,4}, and Brennan M.R. Spiegel, MD, MSHS^{1,3}

¹Cedars-Sinai Center for Outcomes Research and Education (CS-CORE), Los Angeles, CA

²Division of Digestive Diseases, Department of Medicine, UCLA, Los Angeles, CA

³Department of Health Policy and Management, UCLA Fielding School of Public Health, Los Angeles, CA

⁴UCLA Center for Health Policy Research, UCLA Fielding School of Public Health, Los Angeles, CA

Abstract

BACKGROUND & AIMS—Guidelines recommend that persons with a high-risk family history of colorectal cancer (CRC) undergo colonoscopy examinations every 5 y, starting when they are 40 y old. We investigated factors associated with colonoscopy screening of individuals with a family history of CRC, focusing on race and ethnicity.

METHODS—In a retrospective study, we analyzed data from the 2009 California Health Interview Survey on persons 40–80 y old with a first-degree relative (mother, father, sibling or child) with CRC who had visited a physician within the past 5 y. Our study included an

Corresponding Author Information: Brennan M.R. Spiegel, MD, MSHS, RFF, FACP, AGAF, Director of Health Services Research, Cedars-Sinai Health System, Director, Cedars-Sinai Center for Outcomes Research and Education (CS-CORE), Professor-in-Residence of Medicine, Pacific Theatres Building, 116 North Robertson Boulevard, 4th Floor, Los Angeles, CA 90048, Brennan.Spiegel@cshs.org.

Disclosures: None

Writing Assistance: None

Author Contributions:

- Christopher V. Almario, MD: Study concept and design, acquisition of data, analysis and interpretation of data, statistical analysis, drafting of the manuscript, critical revision of the manuscript for important intellectual content, approval of the final version of the manuscript.
- Folasade P. May, MD, MPhil: Study concept and design, analysis and interpretation of data, statistical analysis, drafting of the manuscript, critical revision of the manuscript for important intellectual content, approval of the final version of the manuscript.
- Ninez A. Ponce, MPP, PhD: Study concept and design, analysis and interpretation of data, statistical analysis, critical revision of the manuscript for important intellectual content, approval of the final version of the manuscript.
- Brennan M.R. Spiegel, MD, MSHS: Study concept and design, analysis and interpretation of data, statistical analysis, drafting of the manuscript, critical revision of the manuscript for important intellectual content, approval of the final version of the manuscript.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

unweighted and population-weighted sample of 2539 and 870,214 individuals with a family history of CRC, respectively. We performed a survey-weighted logistic regression analyses to adjust for relevant demographic and socioeconomic variables and used estimates to calculate relative risks (RR) and 95% confidence intervals (CI) for colonoscopy examination within the past 5 y.

RESULTS—In the weighted sample, 60.0% of subjects received a colonoscopy within the past 5 y. A physician recommendation for CRC screening increased the odds that an individual would undergo colonoscopy examination (RR, 1.89; 95% CI, 1.61–2.24). Latinos were 31% less likely to receive colonoscopies than Whites (95% CI, 7%–55%). Among individuals 40–49 y old, African Americans were 71% less likely to have had a colonoscopy than Whites (95% CI, 13%–96%).

CONCLUSION—Based on an analysis of data from the California Health Interview Survey, less than two-thirds of individuals with a family history of CRC reported receiving guideline-recommended colonoscopy examinations within the past 5 y. We observed racial and ethnic disparities in colonoscopy screening of this high-risk group; Latinos and African Americans were less likely to have had a colonoscopy than Whites.

Keywords

colon cancer; prevention; demographics; detection

BACKGROUND & AIMS

Colorectal cancer (CRC) is the third leading cause of cancer-related deaths in the United States (U.S.).¹ Yet, over the past two decades, CRC incidence and mortality has decreased secondary to CRC screening programs.² For individuals with a high-risk family history of CRC, it is recommended they undergo screening colonoscopy every 5 years starting by age 40, or 10 years younger than the age at diagnosis of the youngest affected relative.^{3, 4} Earlier screening for those with a CRC family history is vital given their markedly increased personal risk for developing CRC compared to those without a family history.^{5, 6} Moreover, 30% of all CRCs have an inherited component.^{7, 8}

There is increasing attention to suboptimal CRC screening uptake and poorer CRC outcomes in racial/ethnic minorities in the U.S. when compared to White Americans.^{9–18} Few studies, however, have examined the impact of race/ethnicity on CRC screening rates among individuals with a family history of CRC.^{19–21} Because individuals with a family history of CRC are at marked risk for also developing CRC and have the most to benefit from colonoscopy screening, we evaluated whether racial/ethnic disparities in screening persist in this high-risk group. Based on known racial/ethnic disparities in the broader CRC screening population, we theorized that these disparities would also be evident in subjects with a family history of CRC. Namely, we hypothesized that racial/ethnic minorities with a family history of CRC, compared to White subjects, would be less likely to receive guideline-recommended colonoscopy. To test our hypothesis, we performed a survey-weighted logistic regression model using data from the California Health Interview Survey (CHIS), as it is the largest state health survey and captures the rich racial/ethnic and linguistic diversity of California.

METHODS

Study Design

We performed a cross-sectional study using CHIS 2009 data, as it was the latest year in which CRC screening information was collected.²² CHIS is a population-based telephone survey of California's population that has been conducted by the UCLA Center for Health Policy Research every other year since 2001. It is the largest health survey conducted in any state and also one of the largest health surveys nationwide.²² CHIS collects extensive data for all age groups on health status, health conditions, health-related behaviors, insurance status, as well as access to healthcare.

The CHIS sample is designed to provide estimates for most counties and groups of counties with small populations and to also provide estimates of California's overall population as well as major and smaller racial/ethnic groups. To achieve this, CHIS employed a multi-stage sample design and used random-digit-dial to both landline and cellular services to contact potential participants. Our study was exempt from Institutional Board Review.

Study Population

Individuals who were between 40 and 80 years old, had a family history of CRC, and visited a physician within the past 5 years were included in this study. Although national guidelines define high-risk family history as having a single first-degree relative with CRC or advanced adenoma diagnosed at age < 60 years or two first-degree relatives with CRC or advanced adenomas,^{3, 4} CHIS did not acquire all this information. Therefore, family history of CRC in this study was pragmatically defined as having a first-degree relative diagnosed with CRC at any point during their lifetime. CHIS 2009 also did not ascertain information regarding personal history of CRC. Therefore, we were unable to exclude individuals with a prior history of CRC.

Outcomes

Our primary outcome measure was colonoscopy utilization within the past 5 years. The 5 year limit was chosen because guidelines recommend that all individuals with a high-risk family history of CRC undergo a colonoscopy every 5 years.^{3, 4} Each CHIS participant over the age of 40 years was asked: "have you ever had a colonoscopy?", and those who said "yes" were then asked: "when did you have your most recent colonoscopy to check for colon cancer?"

Our secondary outcome was provision of any CRC screening, which included performing either a colonoscopy, a sigmoidoscopy within the past 5 years, or a fecal-based test within the past year. These time limits were used because they are the recommended intervals for average CRC risk individuals.^{3, 4}

Covariates

Drawing on the Andersen Behavioral Model of Access to Health Services,²³ we identified predisposing (personal demographics and socioeconomic status), enabling, and need factors that may have influenced colonoscopy utilization. Race/ethnicity was defined according to

the UCLA Center for Health Policy Research classification of five mutually exclusive racial/ethnic categories: White, African American, Latino, Asian, and Other (American Indian, Alaskan Native, multiracial). Other demographic variables included age, gender, marital status, number of years in the U.S., English proficiency, general health condition, and household size. Socioeconomic status variables included employment status and highest level of education. Enabling variables included federal poverty level, insurance status, and usual source of care other than the emergency department. Our variable for evaluated need was physician recommendation for CRC screening. CHIS asked all participants over the age of 40 years whether their doctor recommended a colonoscopy, sigmoidoscopy, or stool blood test within the past 5 years.

Statistical Analysis

All statistical analyses were performed in Stata 13.1 (StataCorp LP, College Station, TX) and a two-tailed p-value of less than .05 was considered statistically significant. We applied survey weights to the sample data to produce population estimates, consistent with previous CHIS studies.^{17, 18, 20, 21} Categorical and continuous variables were compared using the chi-squared test and adjusted Wald test, respectively.

We performed multivariate analyses to adjust for potentially confounding factors. All variables previously described were included in the regression models. Initially, we performed a survey-weighted bivariate probit regression model because of possible unobserved differences between individuals who received a physician recommendation for CRC screening and those who did not, thereby raising concern for selection bias. However, the Wald test of rho from the bivariate probit regression model did not reveal evidence of endogeneity ($p=.99$), arguing against selection bias. In the absence of such bias, we used a survey-weighted logistic regression model, which was more consistent and efficient compared to the bivariate probit regression. For all analyses, estimates from the survey-weighted logistic regression models were used to calculate average relative risks (RR) and bias-corrected 95% confidence intervals (CI) using the counterfactual method and bootstrap method with 2000 replications, respectively.

RESULTS

Study Population

In 2009, CHIS collected data from 47,614 individuals and survey weighting yielded a sample of 27,546,591 individuals. Among this group, 3031 (survey-weighted 1,079,661) individuals reported a family history of CRC. The prevalence of family history of CRC in our study (3.9%) was comparable to national data.²⁴ Of those with a CRC family history, 492 (survey-weighted 209,447) persons were excluded either because they were not between 40 to 80 years old or had not seen a doctor within the past 5 years. Therefore, our study included an unweighted and population-weighted sample of 2539 and 870,214 individuals, respectively. Table 1 depicts the characteristics of the population.

CRC Screening Utilization Rates

Overall, 521,600 of the weighted sample (60.0%) reported having undergone a guideline-recommended colonoscopy within the past 5 years. With respect to non-guideline recommended screening, 21,649 (2.5%) only had a sigmoidoscopy within the past 5 years, 54,622 (6.3%) only performed a fecal-based test within the past year, and 15,819 (1.8%) had both a sigmoidoscopy and fecal-based test. Therefore, 613,690 (70.5%) reported having undergone any form of CRC screening.

With respect to race/ethnicity, there were significant differences ($p < .001$) in rates of physician recommendation for CRC screening between Whites ($n=423,541$; 69.9%), African Americans ($n=21,153$; 40.0%), Latinos ($n=33,863$; 38.9%), Asians ($n=37,055$; 51.0%), and Other ($n=30,556$; 59.2%). Table 2 shows the CRC screening rates according to modality and race/ethnicity. Whites (64.5%) and Asians (68.1%) had the highest rates of colonoscopy utilization, while Latinos (33.2%), African Americans (49.5%), and Other (50.1%) had significantly lower rates ($p < .001$). Similar disparities were seen when comparing provision of any form of CRC screening ($p = .002$). No differences were seen in sigmoidoscopy and fecal-based test rates among the racial/ethnic groups.

Predictors of Colonoscopy Utilization

Table 3 depicts the relative risks for colonoscopy utilization. The variable most predictive of colonoscopy utilization was physician recommendation for CRC screening. Those who reported receiving a physician recommendation were 89% more likely (95% CI, 61%–124%) to have undergone a colonoscopy within the past 5 years versus those without a recommendation, even after adjusting for all covariates in the model. Individuals <50 years of age were 25% less likely (95% CI, 7%–41%) to report having had a colonoscopy compared to those \geq 50 years of age. Work status also predicted colonoscopy utilization, as those who were employed were 13% less likely (95% CI, 3%–24%) to have had a colonoscopy compared to those who were unemployed.

With respect to race/ethnicity, Latinos were 31% less likely (95% CI, 7%–55%) to have had a colonoscopy compared to Whites. A marginal effect was seen among the Other group (RR, 0.79; 95% CI, 0.58–1.01). No differences were seen between African Americans and Asians versus Whites.

Predictors of Provision of Any CRC Screening

We also performed an analysis identifying predictors of receiving any CRC screening (Table 3). Physician recommendation for CRC screening again strongly predicted provision of any CRC screening test. Individuals with insurance were more likely to have had CRC screening versus uninsured individuals. Those who were under the age of 50 years as well as currently working were less likely to report having had any CRC screening. Race/ethnicity was not an independent predictor.

Predictors of Colonoscopy Utilization Among Individuals Between 40 to 49 years old

We performed a subgroup analysis that only included individuals between 40 to 49 years of age. Here, 44.2% (85,782/194,195) reported having had a colonoscopy within the past 5

years. Table 4 shows the relative risks for colonoscopy utilization among this subcohort. Physician recommendation for CRC screening strongly predicted colonoscopy, as did having insurance. Individuals who were married as well as in excellent health were less likely to report having had a colonoscopy.

With regard to race, rates of physician recommendation for CRC screening differed significantly ($p=.04$) between Whites ($n=83,924$; 64.6%), African Americans ($n=3,522$; 22.4%), Latinos ($n=12,989$; 46.9%), Asians ($n=3,469$; 28.7%), and Other ($n=4,441$; 50.2%). African Americans were less likely to report having undergone a colonoscopy versus Whites (Table 4). No differences were seen among Latinos and Asians compared to Whites.

DISCUSSION

Despite carrying an increased risk for developing CRC, less than two-thirds of individuals with a family history of CRC had a colonoscopy within the past 5 years in this large, population-based survey of a high-risk CRC screening group. Race/ethnicity independently predicted colonoscopy utilization, as disparities were seen among Latinos and African Americans compared to Whites.

Perencevich and colleagues previously used CHIS 2009 data to evaluate the effect of CRC family history on CRC screening.²⁰ Within each racial/ethnic group, they compared those with a CRC family history to those without such a history. They found racial/ethnic variations in the effect of CRC family history on screening, as Asians, Whites, and African Americans with a family history of CRC were more likely to undergo colonoscopy compared to their counterparts without such a history. No such effect was seen among Latinos. Our study, in contrast, specifically aimed to identify disparities in colonoscopy utilization rates between racial/ethnic minority groups with a CRC family history versus Whites. By doing so, we noted that Latinos and African Americans were significantly less likely to undergo guideline-recommended screening compared to Whites.

Our finding that Latinos with a family history of CRC were less likely to undergo colonoscopy was similar to that by Ponce et al. who used 2005 CHIS data.²¹ One aspect that distinguishes our study was that rather than using average-risk CRC recommendations for the primary outcome, we defined it as colonoscopy utilization within the past 5 years, the current multi-society guideline recommendation for those with a high-risk CRC family history. Moreover, our current study included individuals 40 to 49 years of age, as national guidelines call for earlier screening. There are many potential reasons why Latinos had a lower rate of guideline-recommended screening. Prior research found that Latinos with a family history of cancer did not have a higher perceived cancer risk,²⁵ were fearful of colonoscopy because it might find cancer, and also found it to be an embarrassing procedure.²⁶ These factors may have lead Latinos to not seek preventive measures for CRC, despite their family history. From the provider side, it is possible that Latinos may have seen physicians who did not regularly conduct a family history assessment or recommend screening. Even with the assistance of translators, physicians seeing non-English speaking patients had difficulty recommending CRC screening given that translation of the recommendation took up much of the visit time.²⁷

In subgroup analysis, African Americans between 40 to 49 years old were less likely to report having had a colonoscopy compared to Whites in the same age group. These results corroborate findings by Murff et al. seen among individuals in twelve southeast states.¹⁹ This finding is concerning because national guidelines already recommend that African Americans with average CRC risk undergo earlier screening starting at age 45.⁴ Patient-, provider-, and system-level factors such as patient CRC risk perception, insufficient physician counseling, and access to colonoscopy, among others, likely contributed to this disparity.²⁸ Similar to prior reports,^{29, 30} we found in multivariate analysis that African Americans, compared to Whites, were less likely to have had a physician recommendation for CRC screening, the strongest driver of colonoscopy uptake (data not shown). Moreover, some African Americans who received a recommendation for colonoscopy may have been less receptive to following through with the procedure due to mistrust of their physician born from decades of exploitation and mistreatment³¹ and prior discrimination.³² Addressing this disparity is critical as African Americans have a higher CRC mortality versus Whites.¹⁰

Overall, we noted that individuals between 40 to 49 years of age were 25% less likely to undergo colonoscopy versus those who were 50 years old. This is worrisome as a 40 year old with a family history of CRC carries the same risk for CRC as an average-risk 50 year old,⁵ thus warranting the earlier screening. Appropriate CRC screening for those with a family history of CRC first requires proper identification of individuals with such a history. Schroy et al. surveyed primary care physicians, and found that only 63% routinely inquired about a family history of CRC.³³ Appropriate CRC screening among this high-risk cohort also requires physicians be aware of the latest guidelines and screening recommendations. Prior research has shown that both guideline knowledge and adherence for CRC screening, both in the context of with and without a CRC family history, was suboptimal.^{14, 33–35} Determining why individuals between 40 to 49 years old, a group more likely to better tolerate and benefit from colonoscopy, were less likely to undergo such screening is worth investigating further.

Our study has important limitations. First, the sample included Californians surveyed through CHIS. Although the California population may not fully reflect other areas of the country, the large sample size and diverse population lend generalizability. There were also limitations related to internal validity for our main inclusion criteria of having a CRC family history and primary outcome of colonoscopy utilization. Namely, CHIS' data is reliant on self-report, which is subject to recall bias. However, previous investigators found both self-reported family history of CRC for first-degree relatives³⁶ and self-reported prior CRC screening to be accurate and valid.^{37–39} An additional limitation is that in 2009, CHIS participants were not asked about their affected family member's age at diagnosis or presence of advanced adenomas, both of which are components of the guidelines' definition of high-risk CRC family history.^{3, 4} Therefore, this study may have overestimated the number of individuals with a true CRC family history, and thereby underestimated the true colonoscopy screening rate among this cohort. However, we would expect the proportion of those without a true family history of CRC to be evenly distributed among the groups, and it thereby should not have impacted the regression analyses.

In summary, in a large and demographically diverse sample of subjects over age 40 with a family history of CRC, less than two-thirds underwent a guideline-recommended colonoscopy within the past 5 years. Racial/ethnic disparities were seen, as Latinos and African Americans were less likely to have had a colonoscopy compared to Whites. Because individuals with a family history of CRC carry a markedly increased risk for also developing CRC, it is important to develop targeted, tailored interventions to address these issues and to ultimately increase colonoscopy screening rates among these at-risk cohorts.

Acknowledgments

Grant Support: Drs. Almario and May were supported by a National Institutes of Health T32 training grant (NIH T32DK07180-40) during their gastroenterology and health services research training at UCLA.

Abbreviations

CHIS	California Health Interview Survey
CI	confidence interval
CRC	colorectal cancer
FPL	federal poverty level
HS	high school
RR	relative risk
U.S.	United States
USOC	usual source of care

References

1. Siegel R, Naishadham D, Jemal A. Cancer statistics, 2012. *CA Cancer J Clin.* 2012; 62:10–29. [PubMed: 22237781]
2. Lieberman D. Progress and challenges in colorectal cancer screening and surveillance. *Gastroenterology.* 2010; 138:2115–26. [PubMed: 20167216]
3. Levin B, Lieberman DA, McFarland B, et al. Screening and surveillance for the early detection of colorectal cancer and adenomatous polyps, 2008: a joint guideline from the American Cancer Society, the US Multi-Society Task Force on Colorectal Cancer, and the American College of Radiology. *Gastroenterology.* 2008; 134:1570–95. [PubMed: 18384785]
4. Rex DK, Johnson DA, Anderson JC, et al. American College of Gastroenterology guidelines for colorectal cancer screening 2009 [corrected]. *Am J Gastroenterol.* 2009; 104:739–50. [PubMed: 19240699]
5. Fuchs CS, Giovannucci EL, Colditz GA, et al. A prospective study of family history and the risk of colorectal cancer. *N Engl J Med.* 1994; 331:1669–74. [PubMed: 7969357]
6. Johns LE, Houlston RS. A systematic review and meta-analysis of familial colorectal cancer risk. *Am J Gastroenterol.* 2001; 96:2992–3003. [PubMed: 11693338]
7. Kastros F, Syngal S. Inherited colorectal cancer syndromes. *Cancer J.* 2011; 17:405–15. [PubMed: 22157284]
8. Jasperson KW, Tuohy TM, Neklason DW, et al. Hereditary and familial colon cancer. *Gastroenterology.* 2010; 138:2044–58. [PubMed: 20420945]
9. Tammana VS, Laiyemo AO. Colorectal cancer disparities: issues, controversies and solutions. *World J Gastroenterol.* 2014; 20:869–76. [PubMed: 24574761]

10. Soneji S, Iyer SS, Armstrong K, et al. Racial disparities in stage-specific colorectal cancer mortality: 1960–2005. *Am J Public Health*. 2010; 100:1912–6. [PubMed: 20724684]
11. Johnson-Kozlow M, Roussos S, Rovniak L, et al. Colorectal cancer test use among Californians of Mexican origin: influence of language barriers. *Ethn Dis*. 2009; 19:315–22. [PubMed: 19769015]
12. Pollack LA, Blackman DK, Wilson KM, et al. Colorectal cancer test use among Hispanic and non-Hispanic U.S. populations. *Prev Chronic Dis*. 2006; 3:A50. [PubMed: 16539791]
13. Jerant AF, Fenton JJ, Franks P. Determinants of racial/ethnic colorectal cancer screening disparities. *Arch Intern Med*. 2008; 168:1317–24. [PubMed: 18574089]
14. Wee CC, McCarthy EP, Phillips RS. Factors associated with colon cancer screening: the role of patient factors and physician counseling. *Prev Med*. 2005; 41:23–9. [PubMed: 15916989]
15. Seeff LC, Nadel MR, Klabunde CN, et al. Patterns and predictors of colorectal cancer test use in the adult U.S. population. *Cancer*. 2004; 100:2093–103. [PubMed: 15139050]
16. Ko CW, Kreuter W, Baldwin LM. Persistent demographic differences in colorectal cancer screening utilization despite Medicare reimbursement. *BMC Gastroenterol*. 2005; 5:10. [PubMed: 15755323]
17. Etzioni DA, Ponce NA, Babey SH, et al. A population-based study of colorectal cancer test use: results from the 2001 California Health Interview Survey. *Cancer*. 2004; 101:2523–32. [PubMed: 15505783]
18. Modiri A, Makipour K, Gomez J, et al. Predictors of colorectal cancer testing using the California Health Inventory Survey. *World J Gastroenterol*. 2013; 19:1247–55. [PubMed: 23482920]
19. Murff HJ, Peterson NB, Fowke JH, et al. Colonoscopy screening in African Americans and Whites with affected first-degree relatives. *Arch Intern Med*. 2008; 168:625–31. [PubMed: 18362255]
20. Perencevich M, Ojha RP, Steyerberg EW, et al. Racial and ethnic variations in the effects of family history of colorectal cancer on screening compliance. *Gastroenterology*. 2013; 145:775–781. e2. [PubMed: 23796457]
21. Ponce NA, Tsui J, Knight SJ, et al. Disparities in cancer screening in individuals with a family history of breast or colorectal cancer. *Cancer*. 2012; 118:1656–63. [PubMed: 22009719]
22. California Health Interview Survey. CHIS 2009 Adult Survey. Los Angeles, CA: UCLA Center for Health Policy Research; 2012.
23. Andersen RM. National health surveys and the behavioral model of health services use. *Med Care*. 2008; 46:647–53. [PubMed: 18580382]
24. Ramsey SD, Yoon P, Moonesinghe R, et al. Population-based study of the prevalence of family history of cancer: implications for cancer screening and prevention. *Genet Med*. 2006; 8:571–5. [PubMed: 16980813]
25. Orom H, Kiviniemi MT, Underwood W 3rd, et al. Perceived cancer risk: why is it lower among nonwhites than whites? *Cancer Epidemiol Biomarkers Prev*. 2010; 19:746–54. [PubMed: 20160278]
26. Walsh JM, Kaplan CP, Nguyen B, et al. Barriers to colorectal cancer screening in Latino and Vietnamese Americans. Compared with non-Latino white. *Americans J Gen Intern Med*. 2004; 19:156–66. [PubMed: 15009795]
27. Guerra CE, Schwartz JS, Armstrong K, et al. Barriers of and facilitators to physician recommendation of colorectal cancer screening. *J Gen Intern Med*. 2007; 22:1681–8. [PubMed: 17939007]
28. Bromley EG, May FP, Federer L, et al. Explaining persistent under-use of colonoscopic cancer screening in African Americans: A systematic review. *Prev Med*. 2014; 71c:40–48. [PubMed: 25481094]
29. Coleman Wallace DA, Baltrus PT, Wallace TC, et al. Black white disparities in receiving a physician recommendation for colorectal cancer screening and reasons for not undergoing screening. *J Health Care Poor Underserved*. 2013; 24:1115–24. [PubMed: 23974385]
30. Taylor V, Lessler D, Mertens K, et al. Colorectal cancer screening among African Americans: the importance of physician recommendation. *J Natl Med Assoc*. 2003; 95:806–12. [PubMed: 14527047]
31. Gamble VN. Under the shadow of Tuskegee: African Americans and health care. *Am J Public Health*. 1997; 87:1773–8. [PubMed: 9366634]

32. Armstrong K, Putt M, Halbert CH, et al. Prior experiences of racial discrimination and racial differences in health care system distrust. *Med Care*. 2013; 51:144–50. [PubMed: 23222499]
33. Schroy PC 3rd, Barrison AF, Ling BS, et al. Family history and colorectal cancer screening: a survey of physician knowledge and practice patterns. *Am J Gastroenterol*. 2002; 97:1031–6. [PubMed: 12008667]
34. Saini SD, Nayak RS, Kuhn L, et al. Why don't gastroenterologists follow colon polyp surveillance guidelines?: results of a national survey. *J Clin Gastroenterol*. 2009; 43:554–8. [PubMed: 19542818]
35. Barrison AF, Smith C, Oviedo J, et al. Colorectal cancer screening and familial risk: a survey of internal medicine residents' knowledge and practice patterns. *Am J Gastroenterol*. 2003; 98:1410–1416. [PubMed: 12818289]
36. Murff HJ, Spigel DR, Syngal S. Does this patient have a family history of cancer? An evidence-based analysis of the accuracy of family cancer history. *JAMA*. 2004; 292:1480–9. [PubMed: 15383520]
37. Partin MR, Grill J, Noorbaloochi S, et al. Validation of self-reported colorectal cancer screening behavior from a mixed-mode survey of veterans. *Cancer Epidemiol Biomarkers Prev*. 2008; 17:768–76. [PubMed: 18381474]
38. Madlensky L, McLaughlin J, Goel V. A comparison of self-reported colorectal cancer screening with medical records. *Cancer Epidemiol Biomarkers Prev*. 2003; 12:656–9. [PubMed: 12869407]
39. Khoja S, McGregor SE, Hilsden RJ. Validation of self-reported history of colorectal cancer screening. *Can Fam Physician*. 2007; 53:1192–7. [PubMed: 17872816]

TABLE 1

Characteristics of the study population.

Variable	Weighted sample (N = 870,214)	Weighted % *, †	Standard error *	Unweighted sample (N = 2,539)
CRC screening modality:				
Colonoscopy ‡	521600	60.0	2.2	1623
Sigmoidoscopy only ‡	21649	2.5	0.5	53
Fecal-based test only §	54622	6.3	0.7	170
Sigmoidoscopy ‡ and fecal-based test §	15819	1.8	0.3	53
None within past 5 years	256524	29.5	2.1	640
Physician recommended CRC screening:				
No	324046	37.2	2.1	866
Yes	546168	62.8	2.1	1673
Race/ethnicity:				
White	605958	69.6	2.0	2060
African American	52911	6.1	0.9	107
Latino	86990	10.0	1.9	110
Asian	72720	8.4	1.1	142
Other	51635	5.9	0.8	120
Age:				
50 years old	676019	77.7	2.2	2236
< 50 years old	194195	22.3	2.2	303
Sex:				
Female	508519	58.4	2.1	1632
Male	361695	41.6	2.1	907
Marital Status:				
Unmarried	284798	32.7	2.1	1073
Married	585416	67.3	2.1	1466
Years lived in the U.S.:				
Born in the U.S.	691116	79.4	2.5	2210
< 1 – 14	14447	1.7	0.4	33
15	164651	18.9	2.5	296
English proficiency:				
Not at all or not well	57546	6.6	1.9	68
Only or very well or well	812668	93.4	1.9	2471
Self-reported health status:				
Poor or fair	184364	21.2	2.5	436

Variable	Weighted sample (N = 870,214)	Weighted % *, †	Standard error *	Unweighted sample (N = 2,539)
Good or very good	528826	60.8	2.3	1575
Excellent	157024	18.0	1.1	528
Household size	-	2.5 (mean)	0.1	2.0 (mean)
Work status:				
Not working	409248	47.0	1.8	1332
Currently working	460966	53.0	1.8	1207
Education level:				
Did not graduate from high school	71601	8.2	1.3	129
High school degree	374370	43.0	2.0	1011
College degree	276811	31.8	2.2	870
Graduate degree	147432	16.9	1.1	529
Federal poverty level (FPL):				
300% FPL	561384	64.5	2.2	1701
200 – 299% FPL	119731	13.8	1.6	350
100 – 199% FPL	128656	14.8	2.2	331
0 – 99% FPL	60443	6.9	0.9	157
Insurance status:				
No insurance	94468	10.9	2.6	143
Has insurance	775746	89.1	2.6	2396
Usual source of care (USOC):				
No USOC	49664	5.7	0.8	138
Has USOC	820550	94.3	0.8	2401

CRC, colorectal cancer; U.S., United States.

* Data are presented as percent unless otherwise indicated.

† Columns may not add up to 100% due to rounding.

‡ Performed within past 5 years.

§ Performed within past year.

TABLE 2

Colorectal cancer screening rates according to modality and race/ethnicity.

CRC screening modality	White (N = 605,958)	African American (N = 52,911)	Latino (N = 86,990)	Asian (N = 72,720)	Other (N = 51,635)	p-value
Colonoscopy †	391075 (64.5%)	26166 (49.5%)	28920 (33.2%)	49545 (68.1%)	25894 (50.1%)	<.001 *
Sigmoidoscopy only ‡	15903 (2.6%)	1187 (2.2%)	2649 (3.0%)	1129 (1.6%)	781 (1.5%)	.83 *
Fecal-based test only ‡	33941 (5.6%)	7285 (13.8%)	6250 (7.2%)	2295 (3.2%)	4851 (9.4%)	.12 *
Sigmoidoscopy † and fecal-based test ‡	11582 (1.9%)	384 (0.7%)	1805 (2.1%)	0 (0%)	2048 (4.0%)	.29 *
Any screening test	452501 (74.7%)	35022 (66.2%)	39624 (45.6%)	52969 (72.8%)	33574 (65.0%)	.002 *

Data are presented as n (%).

CRC, colorectal cancer.

* Chi-squared test.

† Performed within past 5 years.

‡ Performed within past year.

TABLE 3

Relative risks for undergoing colonoscopy and any CRC screening.*

Variable	Underwent colonoscopy † (N = 521,600)		Underwent any CRC screening ‡ (N = 613,690)	
	n (%)	Relative risk [95% CI]	n (%)	Relative risk [95% CI]
Physician recommended CRC screening:				
No	122071 (37.7%)	reference	156881 (48.4%)	reference
Yes	399529 (73.2%)	1.89 [1.61–2.24]	456809 (83.6%)	1.72 [1.49–2.01]
Race/ethnicity:				
White	391075 (64.5%)	reference	452501 (74.7%)	reference
African American	26166 (49.5%)	0.92 [0.66–1.20]	35022 (66.2%)	1.03 [0.81–1.27]
Latino	28920 (33.2%)	0.69 [0.45–0.93]	39624 (45.6%)	0.89 [0.65–1.10]
Asian	49545 (68.1%)	1.16 [0.85–1.51]	52969 (72.8%)	1.10 [0.81–1.45]
Other	25894 (50.1%)	0.79 [0.58–1.01]	33574 (65.0%)	0.91 [0.71–1.12]
Age:				
50 years old	435818 (64.5%)	reference	515653 (76.3%)	reference
< 50 years old	85782 (44.2%)	0.75 [0.59–0.93]	98037 (50.5%)	0.72 [0.60–0.85]
Sex:				
Female	308051 (60.6%)	reference	362791 (71.3%)	reference
Male	213549 (59.0%)	1.05 [0.93–1.22]	250899 (69.4%)	1.08 [0.98–1.23]
Marital Status:				
Unmarried	160114 (56.2%)	reference	191391 (67.2%)	reference
Married	361486 (61.7%)	0.98 [0.84–1.16]	422299 (72.1%)	0.94 [0.84–1.08]
Years lived in the United States:				
Born in the United States	426571 (61.7%)	reference	506841 (73.3%)	reference
< 1 – 14	6299 (43.6%)	0.76 [0.30–1.41]	6638 (45.9%)	0.74 [0.39–1.15]
15	88730 (53.9%)	1.01 [0.76–1.33]	100211 (60.9%)	1.01 [0.80–1.29]
English proficiency:				

Variable	Underwent colonoscopy † (N = 521,600)		Underwent any CRC screening ‡ (N = 613,690)	
	n (%)	Relative risk [95% CI]	n (%)	Relative risk [95% CI]
Not at all or not well	20940 (36.4%)	reference	21501 (37.4%)	reference
	500660 (61.6%)	0.96 [0.72–1.84]	592189 (72.9%)	1.17 [0.85–2.41]
Self-reported health status:				
Poor or fair	102674 (55.7%)	reference	122285 (66.3%)	reference
Good or very good	326208 (61.7%)	1.00 [0.83–1.22]	380361 (71.9%)	0.95 [0.82–1.11]
Excellent	92718 (59.0%)	0.93 [0.76–1.18]	111044 (70.7%)	0.92 [0.76–1.09]
Work status:				
Not working	264074 (64.5%)	reference	314372 (76.8%)	reference
Currently working	257526 (55.9%)	0.87 [0.76–0.97]	299318 (64.9%)	0.84 [0.76–0.93]
Education level:				
Did not graduate from HS	36424 (50.9%)	reference	41542 (58.0%)	reference
HS degree	193142 (51.6%)	0.82 [0.64–1.08]	243362 (65.0%)	0.96 [0.78–1.24]
College degree	192086 (69.4%)	1.06 [0.83–1.52]	212738 (76.9%)	1.10 [0.87–1.51]
Graduate degree	99948 (67.8%)	0.97 [0.75–1.36]	116048 (78.7%)	1.08 [0.86–1.45]
Federal poverty level (FPL):				
300% FPL	362667 (64.6%)	reference	425626 (75.8%)	reference
200 – 299% FPL	62123 (51.9%)	0.95 [0.78–1.14]	70884 (59.2%)	0.86 [0.72–1.01]
100 – 199% FPL	67420 (52.4%)	1.00 [0.81–1.27]	81086 (63.0%)	0.97 [0.82–1.20]
0 – 99% FPL	29390 (48.6%)	1.09 [0.84–1.45]	36094 (59.7%)	1.05 [0.82–1.32]
Insurance status:				
No insurance	35766 (37.9%)	reference	38375 (40.6%)	reference
Has insurance	485834 (62.6%)	1.33 [0.91–2.55]	575315 (74.2%)	1.56 [1.02–2.79]
Usual source of care (USOC):				
No USOC	17831 (36.0%)	reference	19413 (39.1%)	reference
Has USOC	503769 (61.4%)	1.21 [0.88–2.03]	594277 (72.4%)	1.28 [0.95–2.06]

Data are presented as n (%) or relative risk [95% CI].

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

CI, confidence interval; CRC, colorectal cancer; HS, high school.

* Relative risk analysis performed on estimates from logistic regression models with survey weights. All variables in the table as well as household size were included in the models.

[†] Performed within past 5 years.

[‡] Performed either a colonoscopy or sigmoidoscopy within past 5 years or fecal-based test within past year.

TABLE 4

Relative risks for undergoing colonoscopy among individuals 40 to 49 years of age.*

Variable	Underwent colonoscopy † (N = 85,782)	Relative risk [95% CI] ‡
Physician recommended CRC screening:		
No	16738 (19.5%)	reference
Yes	69044 (63.7%)	4.08 [1.99–8.53]
Race/ethnicity:		
White	66976 (51.6%)	reference
African American	2347 (14.9%)	0.29 [0.04–0.87]
Latino	8371 (30.2%)	0.67 [0.15–1.94]
Asian	3711 (30.7%)	0.85 [0.20–1.80]
Other	4377 (49.5%)	1.02 [0.06–2.51]
Sex:		
Female	39478 (40.5%)	reference
Male	46304 (47.8%)	1.05 [0.66–1.95]
Marital Status:		
Unmarried	37733 (54.2%)	reference
Married	48049 (38.6%)	0.57 [0.38–0.89]
Years lived in the United States:		
Born in the United States	54099 (39.9%)	reference
< 1 – 14	1224 (22.0%)	0.38 [0.04–1.15]
15	30459 (57.5%)	1.23 [0.48–4.31]
English proficiency:		
Not at all or not well	6470 (36.0%)	reference
Only or very well or well	79312 (45.0%)	1.26 [0.48–10.0]
Self-reported health status:		
Poor or fair	31611 (65.9%)	reference
Good or very good	41013 (37.3%)	0.59 [0.41–1.04]
Excellent	13158 (36.3%)	0.45 [0.24–0.80]
Work status:		
Not working	33812 (50.8%)	reference
Currently working	51970 (40.7%)	0.92 [0.57–2.17]
Education level:		
Did not graduate from HS	8506 (39.4%)	reference
HS degree	23281 (30.5%)	0.97 [0.46–8.82]
College degree	41262 (64.0%)	1.79 [0.71–32.9]
Graduate degree	12733 (40.2%)	1.02 [0.44–13.1]

Variable	Underwent colonoscopy [†] (N = 85,782)	Relative risk [95% CI] [‡]
Federal poverty level (FPL):		
300% FPL	47518 (44.1%)	reference
200 – 299% FPL	3904 (23.0%)	0.55 [0.16–1.09]
100 – 199% FPL	23575 (50.0%)	1.27 [0.41–4.66]
0 – 99% FPL	10785 (48.3%)	1.07 [0.49–3.82]
Insurance status:		
No insurance	19073 (45.1%)	reference
Has insurance	66709 (43.9%)	8.62 [1.06–200.9]
Usual source of care (USOC):		
No USOC	8095 (35.0%)	reference
Has USOC	77687 (45.4%)	1.22 [0.53–7.20]

Data are presented as n (%) or relative risk [95% CI].

CI, confidence interval; CRC, colorectal cancer; HS; high school.

* Relative risk analysis performed on estimates from a logistic regression model with survey weights. All variables in the table as well as household size were included in the model.

[†] Performed within past 5 years.

[‡] One or more parameters could not be estimated in 205 bootstrap replicates; therefore estimates are from 1795 bootstrap replicates.