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Disparities in colorectal cancer screening among South Asians in New York City: A cross-sectional study

Laura C. Wyatt, MPH,

Department of Population Health, NYU School of Medicine, New York, NY USA

Shilpa Patel, PhD,

Center for Healthcare Strategies, Inc., Hamilton, NJ USA

Julie A. Kranick, MA,

Department of Population Health, NYU School of Medicine, New York, NY USA

Victoria H. Raveis, PhD

Psychological Research Unit on Health, Aging, and the Community, College of Dentistry, New York University, New York, NY USA

Joseph E. Ravenell, MD,

Stella S. Yi, PhD,

Simona C. Kwon, DrPH,

Nadia S. Islam, PhD

Department of Population Health, NYU School of Medicine, New York, NY USA

Abstract

Despite improvements in colorectal cancer (CRC) screening in New York City (NYC) since the early 2000s, the degree to which disparities persist for specific Asian American subgroups has yet to be fully elucidated. The purpose of this study is to examine disparities in rates of timely colonoscopy screening among five racial/ethnic groups in NYC. We performed a retrospective cross-sectional analysis of combined 2014–2018 NYC Community Health Survey data. Prevalence estimates of timely colonoscopy screening (within the past 10 years) among individuals 50 years of age were calculated and presented overall (n=24,288) and by socio-demographic variables. Racial/ethnic categories included White, Black, Hispanic, East Asian, and South Asian. Multivariable models examined socio-demographic and racial/ethnic predictors of timely colonoscopy screening. A trend analysis examined colonoscopy screening by race/ethnicity

Corresponding Author: Laura Catherine Wyatt, MPH, Address: NYU School of Medicine, 180 Madison Avenue, 8-25C, New York, NY 10016, laura.wyatt@nyulangone.org, Telephone: 646-501-3491.

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Code availability: Code was run through SAS-callable SUDDAN and is available upon request.

and year from 2012–2018 (n=33,130). Age-adjusted prevalence of timely colonoscopy screening was lowest among Asian Americans (South Asian 61.1% and East Asian 65.9%) compared to Hispanics (71.3%), Blacks (70.2%), and Whites (68.6%). Adjustment by socio-demographics, including insurance status, further explained disparities for South Asians (adjusted relative risk [RR]=0.84, 95% CI=0.73–0.97), compared to Hispanics; additionally, Whites (adjusted RR=0.88, 95% CI=0.84–0.92) were less likely to have received a timely colonoscopy compared to Hispanics. Age, health insurance, poverty group, and education were significant predictors in adjusted regression. Results indicate that South Asians have not equally benefited from campaigns to increase colonoscopy screening in NYC. Our findings support the development of targeted, linguistically- and culturally-adapted campaigns that facilitate access to health systems and leverage existing community assets and social support systems among South Asian populations.

Keywords

Colorectal cancer; colonoscopy; South Asian; Asian American; health disparities

Introduction

The most effective way to reduce the risk of colorectal cancer is routine screening, which can find precancerous polyps before they turn into cancer. Recommended screening tests include stool based tests, such as a yearly fecal immunochemical test (FIT) or a yearly fecal occult blood test (FOBT), or visual exams, such as a colonoscopy every 10 years or a flexible sigmoidoscopy every 5 years, and screening age recommendations for average risk individuals were recently lowered to begin at age 45. However, if a test other than colonoscopy reveals abnormal results, a colonoscopy must be performed to complete the screening process [1]. In 2003, the New York City Department of Health and Mental Hygiene (NYC DOHMH), in partnership with the Citywide Colon Cancer Control Coalition (C5), launched a campaign that focused on increasing colonoscopy screening among under-screened groups in NYC in order to reduce colorectal cancer (CRC) incidence and mortality [2, 3]. Colonoscopy was recommended as it is relatively safe, examines the entire colon, polyps can be detected and removed, and biopsies can be performed for suspicious lesions. FOBT, an alternative recommendation, was considered less optimal due to its lower sensitivity and annual testing over many years; in comparison to a colonoscopy every 10 years, it is more difficult for a program to implement and assess annual FOBT testing.

The goals of the NYC DOHMH and the advisory committee were to increase colonoscopy screening rates for all New Yorkers 50 years of age and to eliminate racial and ethnic screening disparities in colonoscopy screening. Initiatives included: radio and poster campaigns in English and Spanish as well as widely-distributed NYC health bulletins in English, Spanish, Russian, Mandarin, and Cantonese; publications and outreach to health care providers; brief, targeted messages delivered to primary care offices by DOHMH representatives in areas of NYC with high incidence of CRC morbidity and mortality; patient navigator programs utilizing trained staff to help patients complete a colonoscopy; direct endoscopic referral by primary health professionals to eliminate the need for consultation before colonoscopy; and a quality initiative to ensure the quality of

colonoscopies. Using 2009 NYC CHS data, the DOHMH identified disparities for Russian- and Chinese-speaking communities; culturally and linguistically tailored interventions, including aggressive media campaigns and provider education, were implemented in those neighborhoods. Finally, a project focused on NYC's uninsured, and freestanding endoscopy centers provided free colonoscopy screenings to uninsured patients referred by community health centers.

Largely due to the initiative between the NYC DOHMH and C5, the overall timely colonoscopy screening rate (within the past 10 years) among individuals in NYC aged 50 has greatly improved, with an increase of 27% (42% in 2003 to 69% in 2016) in the overall NYC population [3–5]. While disparities among the four major racial/ethnic groups (Whites, Blacks, Hispanics, and Asians) in NYC appears to have closed in 2013 [2], more recent data suggests that disaggregation of Asian and Hispanic racial/ethnic sub-groups may unmask important disparities within these groups [7, 8].

Precipitated in part by increased immigration, Asian Americans are the fastest growing racial/ethnic group in the country, with over 20 million individuals living in the US representing more than 50 sub-ethnicities [9–11]. In NYC, the Asian American population grew by 49.5% between 2000 and 2015, while South Asians, comprised of individuals from countries including India, Pakistan, Bangladesh, and Nepal, saw a particularly high growth in NYC; between 2000 and 2015, the Bangladeshi population increased by 136% [10, 12], and between 2015 and 2017 by 12% [10].

National and regional data also suggest that Asian Americans (both overall and specific subgroups) experience disparities in CRC screening and morbidity when compared to other racial/ethnic groups. The California Cancer Registry data identified high rates of invasive CRC among South Asian, Korean, and Filipino females and Korean males. In comparison to decreasing incidences occurring among non-Hispanic Whites, non-Hispanic Blacks, and Hispanics, incidence rates are dramatically increasing among Koreans, as well as among South Asian and Filipino females [13]. Further, results from national and regional surveys have found low CRC screening rates among Asian Americans when compared to overall and White screening rates [7, 14–19], especially among South Asians [7, 14, 15, 19]. The NYC Community Health Survey (CHS) found that among Asians, timely colonoscopy screening rates among Koreans were lowest (47.8%), followed by South Asians (58.0%) [7] in 2013–2015. A community-based study in metropolitan NY and NJ found that among a sample of foreign-born South Asians, 62% had never had a CRC screening test [20]. Finally, a qualitative study conducted among South Asian immigrants in NYC, specifically Asian Indian, Pakistani, Bangladeshi, and Nepali individuals, found that challenges to CRC screening included lack of knowledge on CRC and CRC screening, lack of outreach, lack of information in-language, and cost, with a physician referral being the most cited facilitator to CRC screening [21].

Population health interventions generally consist of upstream interventions for reaching the wider population and yielding broad improvements in outcome, but often these strategies are not representative of health disparity populations, but are based on research conducted in the majority dominant population [22–24]. Efforts to increase CRC screening rates in NYC

are frequently cited as a successful effort that integrated citywide systems and organizational interventions that improved CRC screening rates at a population health level and decreased disparities among racial and ethnic minorities [2, 3]. However, more research is needed on CRC screening among disaggregated Asian American subgroups in NYC, in order to present a more complete picture of this change. The purpose of this paper is to examine rates of timely colonoscopy screening among five racial/ethnic groups in NYC, Whites, Blacks, Hispanics, East Asians and South Asians. We seek to characterize the magnitude of disparities in CRC screening across diverse Asian American subgroups living in NYC when compared to larger racial and ethnic groups.

Materials and Methods

Study Population

This study utilized data from the NYC CHS, an annual cross-sectional telephone survey of non-institutionalized adults aged 18 years living in NYC, who live in a household with a landline telephone or have a cellular telephone. A computer-assisted telephone interviewing (CATI) system was used to collect survey data; a commercial vendor provided a list of telephone numbers, which was used to construct the CHS sampling frame. One adult was randomly selected from each household to complete the survey interview, upon agreement to participate. Interviewing was conducted in English, Spanish, Russian, and Chinese, and in 2018, Bengali and Haitian Creole were added. The average survey length is 25 minutes. Full disposition reports by year can be found on the CHS methodology website, and response rates (from the older definition) range from 29.8% in 2018 to 40.5% in 2014 (revised definitions occurred in 2015) [4, 25]. Data was pooled across five years in order to generate a study sample of Asian Americans that would allow for meaningful statistical analysis. Overall, a total of 44,815 adults completed an interview between 2014 and 2018, and 66,310 adults completed an interview between 2012 and 2018. This was secondary data analysis and did not involve human participants, and thus was considered exempt from institutional review board approval per self-certification.

Measures

The NYC CHS consists of questions that include socio-demographics, health behaviors, and health screening, including cancer screening. Colonoscopy screening was assessed using the question: “Colonoscopy is an exam in which a tube is inserted in the rectum to view the bowel for signs of cancer or other health problems. Have you ever had a colonoscopy?” If the participant answered yes, they were asked: “When was your most recent colonoscopy?” The main outcome measure is timely colonoscopy screening (within the past 10 years) [1]. Our analysis includes only individuals aged 50 and over.

Race/ethnicity was determined using the questions: “Are you Hispanic or Latino/Latina?” (yes or no); “Which one or more of these groups would you say best represents your race?” (White, Black or African American, Asian, Native Hawaiian or Other Pacific Islander, American Indian or Alaska Native, Something else), and “Please tell me which group best represents your Asian heritage or ancestry?” A new variable was created with the following categories (non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic East Asian,

and non-Hispanic South Asian). South Asian ethnic subgroup includes Indian, Bangladeshi, Pakistani, and Nepali ancestry, among others; and East Asian ethnic subgroup includes Chinese, Korean, and Japanese. Anyone self-reporting Hispanic ethnicity was categorized as Hispanic. Anyone reporting multiple races was excluded from analyses. While Chinese and Asian Indian ethnicities were available in NYC CHS data, we chose to use East Asian and South Asian ethnicities; many individuals born in countries other than India (e.g. Pakistan, Nepal, Bangladesh, Guyana) self-identified as Asian Indian.

Additional covariates were based on previous research, and included age (50–64 and 65), gender, birthplace (US-born vs. foreign-born), poverty level (<200%, 200–399%, 400%), insurance status (private, Medicare, Medicaid, other, and uninsured), and education (< high school, high school graduate, some college/technical school, and college graduate). Household income was imputed for those with missing data.

Statistical analysis

A weight was applied to each record, consisting of an adjustment for the probability of selection, and post-stratification weight. The post-stratification weights were created by weighting each record to the population of the United Hospital Fund (UHF) neighborhood, while taking the respondent's age, gender, and race/ethnicity into account. There are 42 UHF neighborhoods in NYC which are based on zip code of the respondent, however, UHF estimates are collapsed into 34 groupings [26]. Socio-demographic variables were run for the overall population and by racial/ethnic subgroup. Population age-adjusted, weighted prevalence estimates of adults reporting timely colonoscopy screening and 95% CIs were calculated for the overall population and by each covariate; Chi-square tests determined significant differences by screening status. Multivariable relative risk regression was performed to determine if race/ethnicity, as well as any covariates, were associated with timely colonoscopy screening. Risk Ratios (RRs) and 95% CIs are presented [27]. The Wald F test presents statistical significance for each covariate, taken from relative risk regression results. Relative risk regression was used, because for more common outcomes, odds ratios overstate the relative risk [5, 27, 28]. Finally, age-adjusted prevalence estimates for timely colonoscopy screening were run for all years asking Asian ethnicity (2012–2018), stratifying by racial/ethnic subgroup; a linear trend p-value value was compared across years using orthogonal trend tests. All data were analyzed using SAS-callable SUDAAN, version 11.0.3 (Research Triangle Institute, Research Triangle Park, NC) in order to take into account the complex survey design.

Results

Of 44,815 adults surveyed, 24,288 were aged 50, self-identified as one of the five racial/ethnic groups, and answered the colonoscopy screening question. All racial/ethnic groups had a large proportion of females, except for South Asians (35.4% females). Additionally, South Asians had a higher proportion of individuals aged 50–64 when compared to other groups (79.9%). Both Asian ethnic subgroups had a small percentage of individuals born in the US (3.2% among East Asians and 1.7% among South Asians), compared to 73.9% among Whites, 54.2% among Blacks, and 33.0% among Hispanics (Table 1).

Table 2 presents timely colonoscopy screening prevalence by each covariate. Of the total weighted population, 69.1% of individuals had received a timely colonoscopy. Individuals aged ≥ 65 were significantly more likely than individuals aged 50–64 to have received a timely colonoscopy ($p < 0.001$), and individuals with any type of health insurance were significantly more likely than uninsured individuals to have received a timely colonoscopy ($p < 0.001$). Significant differences in colonoscopy screening were seen by poverty group and education level ($p < 0.001$). Timely colonoscopy prevalence was also higher among Whites (68.6%), Blacks (70.2%), and Hispanics (71.3%) when compared to both Asian ethnic groups -- East Asians (65.9%) and South Asians (61.2%). While there was no significant difference in timely colonoscopy screening by nativity, an analysis with 2012–2014 data found that individuals living in the US for <5 years and 5–9 years had the lowest prevalence rate for timely colonoscopy (47.0% and 56.3%, respectively), compared to US-born individuals (69.0%), and those living in the US for 10 or more years (70.6%). These differences were significant ($p < 0.001$, data not presented).

Table 3 presents relative risk (RR) regression models predicting timely colonoscopy screening.

In unadjusted regression analysis, South Asians were less likely to have received a timely colonoscopy when compared to Hispanics (RR: 0.84, 95% confidence interval (CI): 0.72–0.97). Blacks and Whites had a similar rate of a timely colonoscopy compared to Hispanics (Blacks – RR: 1.00, 95% CI: 0.96–1.05 and Whites – RR: 0.98; 95% CI: 0.94–1.02). Once placed into adjusted regression analysis, South Asians remained less likely to have received a timely colonoscopy when compared to Hispanics (adjusted RR: 0.84, 95% CI: 0.73–0.97); however, Whites were also less likely to have received a timely colonoscopy screening compared to Hispanics (adjusted RR: 0.88, 95% CI: 0.84–0.92). Additional factors associated with greater likelihood of timely colonoscopy screening included age ≥ 65, any type of health insurance, lower poverty, and education (high school graduate vs. less than high school).

Time trend analysis includes years 2012–2018 ($n = 33,130$). No significant differences in linear trends were seen over time for any of the racial/ethnic subgroups. While variations in timely colonoscopy screenings were observed for South Asians from 2012 to 2014 (50.1% [95% CI –32.9, 67.2] – 2012, 68.5% [95% CI – 55.7, 79.0] – 2013, 50.0% [95% CI – 32.3, 67.8] – 2014), the CI range was wide, confirming the lack of significance between years. East Asians also saw a noticeable change between 2014 and 2017 (72.2% [95% CI 65.6, 78.0] to 60.2% [95% CI 52.5, 67.5]), but this change was also not significant.

Discussion

Our results confirm a low uptake of timely colonoscopy screening among Asian American subgroups living in NYC, South Asians in particular. Furthermore, the magnitude of risk was highest among South Asians compared to other racial/ethnic groups. In fact, our analysis demonstrates that while Whites, Blacks, and Hispanics have similar timely colonoscopy screening rates, Asian American subgroups display significantly lower rates. The South Asian and White subgroups both showed a lower RR of timely colonoscopy

screening in adjusted analyses, demonstrated by CIs less than 1.0, when compared to Hispanics.

A population health equity approach focuses on health outcomes at a population level, rather than at an individual level, in order to address factors from multiple pathways, while taking into account structural and cultural determinants of health [22, 23]. The C5 specifically incorporated several aspects of a health equity approach into their intervention, with an articulated goal to eliminate racial and ethnic screening disparities. For example, the coalition developed advisory groups, utilized patient navigator programs, and disseminated in-language educational campaigns and bulletins [5, 29, 30]. Additionally, the coalition has continued monitoring CRC screening, using annual citywide findings to identify and address ‘emerging data and trends.’ For example, in 2010, data from the NYC Community Health Survey revealed low screening rates within Chinese- and Russian-speaking communities. Utilizing this information, the C5 developed culturally and linguistically tailored interventions to speak directly to this inequity, although the evaluation of these culturally tailored campaigns have not yet been published [2].

Our analysis of the NYC CHS longitudinal data indicate that C5 coalition efforts might have benefited from a deeper targeted health equity approach that more comprehensively addressed colonoscopy screening disparities within additional subgroups of the Asian American community. Given the tremendous diversity represented among Asian Americans, it has been well-documented that data analyzed or reported by overall group categories of race/ethnicity can mask important differences between race/ethnic subgroups [31–33]. Our findings demonstrate that when using innovative strategies (e.g. data pooling) that allow for a more granular subgroup analysis of municipal data, South Asians, the second largest Asian subgroup in NYC, had the lowest colonoscopy screening rate among the groups examined; our findings demonstrated a 61.2% screening rate among South Asians. We also examined colonoscopy screening by ethnicity and insurance status and found that uninsured South Asians were more likely than insured South Asians to have received an up-to-date colonoscopy; however, this interaction was not significant in regression (data not presented). These findings warrant further investigation. With the recognition of the continued lower screening rates within the South Asian community, population-wide cancer screening programs, like the C5, may require plans for targeted interventions to under-represented and under reached populations.

Efforts have begun by the NYC DOHMH and C5 to this effect. Since 2018, colonoscopy patient education materials have been translated into Bengali, and focus groups with Asian Indians and Filipinos on colorectal cancer screening and colonoscopy have been conducted. In June of 2019, an Asian American-focused CRC prevention media campaign was announced based on the focus group results, and was translated into several Asian languages, including Traditional Chinese, Simplified Chinese, Korean, and Bengali [35, 36].

Studies examining CRC screening within South Asian communities have provided valuable insight into effective methods and strategies for closing gaps in screening disparities. One scoping review of cancer screening in the UK, US and Canada among South Asian immigrants identified barriers and facilitators of cancer screenings, including messaging

through the primary care provider, lack of knowledge, in-language and culturally appropriate media campaigns, and raising awareness of the value of screening even if one considers themselves healthy; for instance, some individuals may believe that because they engage in other healthful behaviors, like eating nutritious foods or engaging in regular physical activity, they do not need to be screened for CRC [37]. A recent study examining the impact of a culturally-targeted intervention designed to improve attitudes on and knowledge of CRC screening among South Asians in New Jersey found that there was high acceptability among individuals attending the intervention sessions, as well as a large increase in knowledge and awareness of CRC screening tests. Approximately 30% of pilot study participants completed CRC screening at follow-up, suggesting the need for additional follow-up and patient navigation for this population [38]. Finally, a qualitative investigation in NYC recently published by the authors found a low uptake of CRC screening among South Asian immigrants, as well as low levels of knowledge regarding screening practices [21]. Findings suggest barriers relating to poor access to healthcare, language, and social and cultural beliefs, which are important considerations for the push for CRC screenings among the NYC South Asian older population.

This study has limitations. First, data are from self-report, which may overestimate or underestimate screening uptake due to recall bias [39]. Second, the NYC CHS was conducted in English, Spanish, Russian, and Chinese, with Bengali and Haitian Creole added in 2018 [4]. South Asians with limited English proficiency (LEP) speaking languages other than the ones surveyed may not be accurately reflected in our findings. Third, generalizability may be limited, as NYC is a unique setting in the US. Fourth, because we aggregated datasets across several years and because Asian ancestry was asked starting in 2012, we were unable to examine temporal trends before 2012. Fifth, samples of South Asians were small when examined by year in the trend analysis. Sixth, a low colonoscopy screening rate has been demonstrated among Korean Americans (47.8%) [7], but our analysis did not allow for inclusion of this subgroup due to small sample size. It is worth further mention that Hispanic subgroups were aggregated for this analysis; low colonoscopy screening rates in NYC have also been shown among Mexican Americans (44%) [8, 34]. Further research should investigate CRC screening rates among Korean and Mexican American subgroups. Finally, colonoscopy screening recommendations during the majority of the study are for those 50–75 years of age; for individuals ages 76 through 85, the decision is based on a person's health and other preferences, while people over age 85 are not recommended to be screened for colonoscopy [1]. We included individuals in the analysis age 50 and older in order to maximize our sample size. Future research should consider the exact screening guidelines, as well as guidelines published by the ACS in 2018 and the US Preventive Services Task Force (USPSTF) in 2020 to lower the starting age to 45 [1, 40], a recommendation that has not been fully adopted in clinical practice and is not accepted as recommended screening age by all insurance companies.

We were unable to control for English language proficiency in our analyses. However, a study in New Jersey noted that LEP individuals are less likely to receive CRC screening compared to individuals with higher proficiency; therefore, we anticipate that the inclusion of LEP would likely amplify our findings and should be included on future studies [20]. We were also unable to include years lived in the US in our analyses, because this was

only asked between 2012 and 2014, and again starting in 2018. A study using 2014 NYC CHS found that individuals living in the US for <5 years were significantly less likely than US-born individuals to have a timely colonoscopy screening [34], and a study among South Asians in Chicago found similar results [41]. Recent immigrants may also experience barriers in knowledge related to preventive screenings [42, 43]. Future analyses should include time lived in the US if possible.

Findings from our study fill an important gap in the literature on CRC screening rates among Asian Americans living in NYC. Given the growth of Asian Americans, and in particular South Asian Americans, as well as the impact that CRC has on this population, further studies are essential to understand the barriers and facilitators to CRC screening among this population. Further, it is necessary to understand if the high immigration rates of South Asian Americans in NYC have an effect on the low colonoscopy screening rates; further analysis should examine the relationship between immigration status, time in the US, and timely colonoscopy screening.

Our study findings support the growing literature positing that a fundamental shift in the public health approach is necessary to enhance health equity at the population health level. Despite aggressive citywide efforts, our analysis reveals that South Asians – one of the fastest growing immigrant populations in NYC – have not equally benefitted from campaigns to increase CRC screening. The development of culturally- and linguistically-adapted interventions and messaging campaigns that fit the health literacy levels of the current immigration groups are necessary to facilitate access to health systems and leverage existing community assets and social support systems. Indeed, similar programs have demonstrated a significant impact in improving CRC health disparities for other populations. Researchers and health officials should continue to monitor the Asian and South Asian populations in NYC, given this new, targeted CRC screening campaign.

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Table 1.

Selected weighted characteristics of the study sample aged ≥ 50 overall and by race/ethnicity, NYC CHS 2014–2018

	Entire sample, n=24,288	NH White, n=10,483	NH Black, n=5,684	Hispanic, n=6,319	NH East Asian, n=1,443	NH South Asian, n=359
Sex						
Male	43.4	45.9	40.0	39.2	48.4	64.6
Female	56.6	54.1	60.0	60.8	51.6	35.4
Age						
50–64	60.9	54.3	65.8	65.7	64.2	79.9
65	39.1	45.7	34.2	34.3	35.8	20.1
Birthplace						
United States (US)	53.0	73.9	54.2	33.0	3.2	1.7*
Foreign-born	47.0	26.1	45.8	67.0	96.8	98.3*
Insurance status						
Private	38.2	50.4	40.8	21.0	22.5	41.7
Medicare	33.7	34.8	29.5	32.9	35.4	30.7
Medicaid	19.8	9.4	19.3	34.1	35.0	19.0
Other	2.7	2.4	3.3	3.1	1.7*	1.6*
Uninsured	5.7	3.0	7.1	8.9	5.4	7.0
Poverty group (imputed)						
<200%	47.8	27.4	50.4	73.2	74.6	57.0
200–399%	18.8	19.0	24.7	14.5	11.2	21.8
400%	33.4	53.6	25.0	12.3	14.1	21.2
Education						
< High school	23.0	5.1	20.4	52.8	45.0	24.4
High school graduate	24.2	19.2	34.9	21.2	28.3	27.3
Some college/technical school	20.0	21.9	23.5	15.5	11.1	16.4
College graduate	32.8	53.8	21.2	10.5	15.6	31.9

* Estimate should be interpreted with caution. Estimate's Relative Standard Error (a measure of estimate precision) is greater than 30%, making the estimate potentially unreliable.

Table 2.Bivariate analysis by ever had a colonoscopy in the past 10 years, age \geq 50, NYC CHS 2014–2018

	Colonoscopy in the past 10 years			p-value
	n (unweighted)	% (weighted)	95% CI	
Overall	24,288	69.1	68.2–70.0	
Sex				0.005
Female	14,305	69.9	68.7–71.1	
Male	9,949	68.3	66.9–69.7	
Age				<0.001
50–64	12,286	64.5	63.2–65.7	
65	12,002	74.6	73.2–75.9	
Race or Ethnicity				0.011
NH white	10,483	68.6	67.1–70.0	
NH Black	5,684	70.2	68.2–72.1	
Hispanic	6,319	71.3	69.6–72.9	
NH East Asian	1,443	65.9	62.4–69.2	
NH South Asian	359	61.2	53.9–68.1	
Birthplace				0.133
United States (US)	13,864	69.4	68.2–70.7	
Foreign-born	10,345	69.0	67.7–70.3	
Insurance status				<0.001
Private	8,929	72.6	71.0–74.2	
Medicare	8,559	71.8	69.4–74.1	
Medicaid	4,598	65.9	63.8–68.0	
Other	654	68.2	61.6–74.2	
Uninsured	1,126	47.8	42.2–53.4	
Poverty group (imputed)				<0.001
<200%	11,249	66.1	64.7–67.4	
200–399%	4,467	67.9	65.7–70.1	
400%	8,572	73.9	72.4–75.3	
Education				<0.001
< High school	4,574	68.2	66.2–70.1	
High school graduate	5,447	64.5	62.4–66.5	
Some college/technical school	4,553	69.1	67.0–71.2	
College graduate	9,572	73.0	71.6–74.4	

Table 3.

Multivariable Risk Regression among individuals age 50 predicting colonoscopy screening, NYC CHS 2014–2018

	Colonoscopy in the past 10 years					
	RR	95% CI Interval	P-value*	aRR	95% CI Interval	P-value*
<i>Race/Ethnicity</i>			0.038			<0.001
NH white	0.98	0.94–1.02		0.88	0.84–0.92	
NH Black	1.00	0.96–1.05		0.97	0.93–1.01	
Hispanic	Ref			Ref		
NH East Asian	0.95	0.89–1.02		0.95	0.90–1.01	
NH South Asian	0.84	0.72–0.97		0.84	0.73–0.97	
<i>Sex</i>						0.188
Female				1.02	0.99–1.05	
Male				Ref		
<i>Age</i>						<0.001
50–64				Ref		
65+				1.13	1.09–1.18	
<i>Nativity</i>						0.542
US-born				Ref		
Foreign-born				1.01	0.98–1.05	
<i>Health Insurance</i>						<0.001
Private				1.51	1.35–1.68	
Medicare				1.51	1.35–1.69	
Medicaid				1.36	1.22–1.52	
Other				1.48	1.28–1.71	
Uninsured				Ref		
<i>Poverty group (imputed)</i>						0.001
<200%				Ref		
200–399%				1.03	0.98–1.08	
400%				1.09	1.04–1.14	
<i>Education</i>						<0.001
Less than high school				Ref		
High school graduate				0.94	0.89–0.99	
Some college/technical school				0.98	0.93–1.03	
College graduate				1.03	0.98–1.09	

RR, relative risk; aRR, adjusted relative risk

* P-value from Wald F Test