Published in final edited form as:

Dig Dis Sci. 2021 September ; 66(9): 2907–2915. doi:10.1007/s10620-020-06648-x.

Factors associated with up-to-date colonoscopy use among Puerto Ricans in New York City, 2003–2016

Sandy Ng, MD[1], **Yuhe Xia, MS**[2], **Matthew Glenn, MS**[3], **Neha Nagpal, MD**[1], **Kevin Lin, MD**[1], **Chau Trinh-Shevrin, DrPH**[1,2], **Andrea B. Troxel, ScD**[2], **Simona C. Kwon, DrPH, MPH**[1,2], **Peter S. Liang, MD, MPH**[1,4]

[1]Department of Medicine, NYU Langone Health, 550 First Avenue, New York, NY 10016

[2]Department of Population Health, NYU Langone Health, 550 First Avenue, New York, NY 10016

[3]NYU Grossman School of Medicine, 550 First Avenue, New York, NY 10016

[4]Department of Medicine, VA New York Harbor Health Care System, 423 E 23rd St, 11N GI, New York, NY 10010

Abstract

Background—Colorectal cancer is the second leading cause of cancer death among Hispanic Americans. Puerto Ricans are the second largest Hispanic subgroup in the United States and the largest in New York City, but little is known about predictors of colorectal cancer screening uptake in this population.

Aims—We used the New York City Community Health Survey, a population-based telephone survey, to investigate predictors of up-to-date colonoscopy use over time among Puerto Ricans aged ≥50 years in NYC.

Methods—We assessed the association between sociodemographic and medical factors and up-to-date colonoscopy use (defined as colonoscopy within the last 10 years) using univariable and multivariable logistic regression over six time periods: 2003–2005, 2006–2008, 2009–2010, 2011–2012, 2013–2014, and 2015–2016.

Results—On multivariable analysis, age ≥65 years (OR 1.64–1.93 over three periods) and influenza vaccination (OR 1.86–2.17 over five periods) were the two factors most consistently associated with up-to-date colonoscopy use. Individuals without a primary care provider (OR 0.38–0.50 over three periods) and who did not exercise (OR 0.49–0.52 over two periods) were significantly less likely to have an up-to-date colonoscopy.

Corresponding author: Peter S. Liang, Peter.Liang@nyulangone.org.

Conflict of interests:
The authors declare that they have no conflict of interest.

Conclusions—Older age, influenza vaccination, having a primary care provider, and exercise are independent predictors of up-to-date colonoscopy use among Puerto Ricans in NYC. Interventions to improve screening colonoscopy uptake among Puerto Ricans should be targeted to those aged 50–64 years and who do not have a primary care provider.

Keywords

colorectal cancer; screening; race/ethnicity; Puerto Rican; New York City; minority health

Introduction

Hispanics are the largest ethnic minority group in the United States (US). Among Hispanics, cancer is the leading cause of death and colorectal cancer (CRC) is the second most common cancer [1,2]. CRC screening [1], incidence [2–4], and mortality [5] differ among the various Hispanic subgroups, such as Puerto Ricans, Mexicans, Cubans, Dominicans, and Central/South Americans. Puerto Ricans are the second largest Hispanic subgroup in the US [1], and most individuals reside in New York, Florida, and New Jersey [6,7]. Based on the National Health Interview Survey (NHIS), up-to-date CRC screening among Hispanics in 2015 was only 50% [1]. Puerto Ricans also have a higher age-adjusted CRC mortality rate (25.7 per 100,000 persons) than Mexicans (21.2), Cubans (25.1), Dominicans (13.3), and Central/South Americans (14.3) [8].

Studies have shown that low socioeconomic status, lack of insurance, and reduced access to care are barriers to CRC screening among Hispanics overall [9,10]. However, little is known about specific predictors of CRC screening for Puerto Ricans living in the US mainland. Puerto Ricans are the largest Hispanic subgroup in New York City (NYC), with a population of 723,621 based on recent estimates [11]. We used the NYC Community Health Survey to assess predictors of CRC screening by colonoscopy in the Puerto Rican population.

Methods

We conducted a cross-sectional study using data from the New York City Community Health Survey (NYCCHS) over six contiguous time periods: 2003–2005, 2006–2008, 2009–2010, 2011–2012, 2013–2014, and 2015–2016. The NYCCHS is an annual telephone survey conducted by the NYC Department of Health and Mental Hygiene with self-reported data from adults aged 18 years and older who are randomly selected from the city's five boroughs [12]. We focused on the subset of respondents who were 50 years and older and self-identified as Puerto Rican to assess sociodemographic and medical factors associated with up-to-date colonoscopy use. The telephone survey was conducted in English and Spanish, as well as other languages. Individuals who responded that they had a colonoscopy within the last ten years were considered to be up-to-date for colorectal cancer screening. We extracted sociodemographic data, including age, sex, home language, education, marital status, employment status, income, borough of residence, and insurance status. We also examined factors related to health access and health behavior, such as having a primary care provider, influenza vaccination in the past 12 months, diabetes, body mass index (BMI), consumption of sugar sweetened beverages, exercise, and smoking status. This study (18–

00012) was approved by the NYU School of Medicine Institutional Review Board. For this type of study, formal consent was not required.

Statistical analysis was performed using SAS Enterprise Guide, Version 4.2 (SAS Institute, Inc., Cary, North Carolina) to accommodate the complex survey design. Survey results were weighted to adjust for the probability of selection as well as a post-stratification weight. Multi-year weights were also included to account for the combination of multiple years of data. For each of the six time periods, univariable logistic regression was used to evaluate predictors of colonoscopy, with $P<0.10$ as the criterion for entry into the multivariable model. Age and sex were entered and retained in the model regardless of significance level. The final models were selected by backward stepwise selection until all retained variables had $P<0.10$. We also performed a post hoc analysis to assess for an interaction effect between age and having a primary care provider. Odds ratios (ORs) and their 95% confidence intervals (CIs) were estimated. Statistical significance was defined as a two-sided $P<0.05$.

Results

Table 1 shows the sociodemographic and medical characteristics of Puerto Ricans in NYC over the six time periods and the weighted percentages of those who had an up-to-date colonoscopy. Throughout the study period, unweighted characteristics of the survey respondents indicated that the majority were aged 50 to 64 years, female, not married, not in the labor force, and had not attended college. Overall, up-to-date colonoscopy use was 46.5% in 2003–2005, 61.2% in 2006–2008, 62.6% in 2009–2010, 63.3% in 2011–2012, 69.1% in 2013–2014, and 71.4% in 2015–2016.

On univariable analysis, influenza vaccination was significantly associated with up-to date colonoscopy in all six periods [OR 1.94 (95% CI 1.41–2.67) in 2003–2005, OR 2.27 (95% CI 1.65–3.13) in 2006–2008, OR 1.97 (95% CI 1.22–3.18) in 2009–2010, OR 2.12 (95% CI 1.26–3.55) in 2011–2012, OR 2.25 (95% CI 1.46–3.47) in 2013–2014, OR 1.62 (95% CI 1.02–2.58) in 2015–2016] (Table 2). Age ≥65 years was a positive predictor of up-to-date colonoscopy in four periods [OR 1.68 (95% CI 1.22–2.32) in 2006–2008, OR 1.99 (95% CI 1.15–3.45) in 2011–2012, OR 2.01 (95% CI 1.25–3.23) in 2013–2014, OR 1.61 (95% CI 1.01–2.55) in 2015–2016]. Negative predictors of up-to-date colonoscopy in three periods included lack of a primary care provider [OR 0.48 (95% CI 0.32–0.72) in 2006–2008, OR 0.37 (95% CI 0.19–0.73) in 2013–2014, OR 0.45 (95% CI 0.21–0.97) in 2015–2016], being uninsured [OR 0.31 (95% CI 0.12–0.80) in 2009–2010, OR 0.33 (95% CI 0.13–0.83) in 2011–2012, OR 0.26 (95% CI 0.09–0.75) in 2015–2016], and current smokers [OR 0.38 (95% CI 0.20–0.72) in 2006–2008, OR 0.42 (95% CI 0.22–0.81) in 2011–2012, OR 0.45 (95% CI 0.26–0.77) in 2013–2014]. Participants who spoke Spanish at home, graduated from college, were insured by Medicare, were not in the labor force, and did not drink sugar sweetened beverages were significantly more likely to have an up-to-date colonoscopy in one or two periods. Individuals who lived in Brooklyn or Staten Island, were unemployed, did not exercise, and were not diabetic were significantly less likely to have an up-to-date colonoscopy in one or two periods.

On multivariable analysis, age ≥65 years [OR 1.64 (95% CI 1.15–2.33) in 2006–2008, OR 1.93 (95% CI 1.16–3.19) in 2013–2014, OR 1.73 (95% CI 1.08–2.77) in 2015–2016] and influenza vaccination [OR 1.91 (95% CI 1.38–2.64) in 2003–2005, OR 2.17 (95% CI 1.55–3.05) in 2006–2008, OR 1.86 (95% CI 1.16–2.99) in 2009–2010, OR 1.86 (95% CI 1.08–3.20) in 2011–2012, OR 2.02 (95% CI 1.30–3.14) in 2013–2014] were most consistently associated with receiving an up-to-date colonoscopy (Table 3). Individuals who did not drink sugar sweetened beverages [OR 1.98 (95% CI 1.13–3.46) in 2011–2012] were significantly more likely to have an up-to-date colonoscopy in one time period. The most consistent negative predictive factors for screening were not having a primary care provider [OR 0.50 (95% CI 0.33–0.76) in 2006–2008, OR 0.38 (95% CI 0.20–0.73) in 2013–2014, OR 0.45 (95% CI 0.21–0.99) in 2015–2016] and not exercising [OR 0.52 (95% CI 0.38–0.71) in 2003–2005, OR 0.49 (95% CI 0.30–0.79) in 2015–2016]. Having Medicaid and being uninsured were negative predictors of screening in a single time period [Medicaid: OR 0.44 (95% CI 0.21–0.93); uninsured: OR 0.29 (95% CI 0.12–0.72), both in 2011–2012]. We found no evidence of interaction between age and having a primary care provider.

Figure 1 shows the weighted percentages of up-to-date colonoscopy for the most important predictors on multivariable regression: age, influenza vaccination, primary care provider, and exercise.

Discussion

Data on predictors of CRC screening for Hispanic subgroups, and specifically Puerto Ricans living in the US mainland, is currently limited. This study showed that age and access to preventive care were independent predictors of up-to-date colonoscopy use among Puerto Ricans living in NYC. Individuals aged 65 years or older and who received the influenza vaccination were more likely to be up-to-date, whereas those without a primary care provider and who did not exercise were less likely to be. From 2003 to 2016, CRC screening by colonoscopy increased 25% on the absolute scale (54% on relative scale) in the NYC Puerto Rican population.

Puerto Ricans aged 65 years or older were more likely to have an up-to-date colonoscopy. This finding is consistent with other studies that have examined the overall US population as well as Hispanics in particular [13–15]. Older individuals may have more personal or indirect experience with cancer [14]. One study surveyed 274 Hispanic patients in a San Antonio clinic about their knowledge and attitude about CRC screening, and found that older age and personal history of any cancer were both associated with colonoscopy use [14]. Individuals who are older are also more likely to visit their primary care provider [16]. Adults qualify for Medicare at age 65 years, and coverage for an annual wellness visit increased the rate of preventive visits for older adults [17]. Older individuals generally have chronic medical conditions that require medical visits, which can increase opportunities to discuss CRC screening [18].

Individuals without a primary care provider were also less likely to receive a colonoscopy. Without a primary care provider, individuals may not receive adequate education about CRC or the benefits of screening. Indeed, Hispanics who discussed CRC risks and the

need for screening with their doctor were significantly more likely to get screened [14]. The patient-physician relationship also plays an important role. Napoles et al. surveyed 504 Hispanic patients from one group practice and three safety net clinics in California regarding physician counseling for and patient adherence to CRC screening. They found that Hispanic patients were more likely to undergo screening if their physicians strongly encouraged screening and responded to their concerns [19]. Prior studies using data from NHIS and Hispanic Community Health Study/Study of Latinos have also shown that Hispanic patients who visited their primary care provider within the last year were more likely to receive CRC screening [15,20]. Our results confirm the vital role of the primary care provider in promoting health education and preventive care.

Influenza vaccination was the most consistent predictor of colonoscopy use in our analysis. Similarly, a study of the 2004 National Adult Immunization Survey found that receiving the influenza or pneumonia vaccine predicted up-to-date CRC screening, although only approximately 5% of those participants were Hispanic [21]. Gorin et al. also found that use of other screening tests, such as mammogram, Papanicolaou (Pap) smear, and prostate-specific antigen, were associated with endoscopic CRC screening among Hispanics in the 2000 NHIS [15]. These results indicate that individuals who have engaged in past preventive health behavior were more likely to participate in another preventive service.

Exercise was another preventive health behavior associated with up-to-date colonoscopy use. Our results showed that individuals who did not exercise within the last 30 days were less likely to have up-to-date colonoscopy screening. Hart et al. assessed the association between physical activity and health behavior in 5630 adults, including those of Hispanic ethnicity [22]. Adults who exercised were more likely to have health insurance and engage in healthful behaviors such as consuming fruits and vegetables and not smoking [22]. Other studies have found physical activity to be associated with a lower risk for colorectal cancer, which may be attributed to both the physiologic benefits of exercise as well as a surrogate measure of healthful behavior [23,24].

Up-to-date colonoscopy use in the Puerto Rican population rose from 46.5% to 71.4% during the study period. Much of this improvement can be attributed to the Citywide Colorectal Cancer Control Coalition, which was established in 2003 to promote CRC awareness and increase screening uptake by colonoscopy [25]. One of the goals of this program was to reduce racial/ethnic disparities in screening, which was achieved by offering free screening colonoscopies to the uninsured and targeting minority neighborhoods with low CRC screening. The difference in screening uptake between Hispanics and non-Hispanic Whites in NYC has significantly decreased over the years [25,26]. However, recent data still show lower CRC screening among Hispanics compared to non-Hispanic Whites nationally [27]. This study furthers our understanding about predictors of screening in one of the largest ethnic communities in NYC.

Some study limitations should be noted. First, the NYCCHS is a telephone survey and is subject to participation bias if certain populations are difficult to contact or are otherwise less likely to participate. Second, the survey asks only about colonoscopy and not about other screening modalities for colorectal cancer, such as stool-based testing and flexible

sigmoidoscopy. Therefore, it is possible that the current study underestimates the rate of CRC screening in this population if Puerto Ricans in NYC are more likely to use another screening modality. Third, similar to national surveys such as the NHIS, the NYCCHS did not record information about the clinical indication for colonoscopy. However, the majority of colonoscopies are adequate for CRC screening regardless of the original indication, so total and screening colonoscopy uptake are highly correlated. Moreover, the lack of indication data makes our findings more comparable to the NHIS and increases its external validity. Fourth, the study results pertain to Puerto Ricans in NYC and may not be broadly generalizable to Puerto Ricans residing in other regions.

In conclusion, CRC screening by colonoscopy among Puerto Ricans in NYC has substantially increased from 2003 to 2016. Individuals who are older and participate in preventive care are more likely to receive up-to-date colonoscopy. Targeted intervention for adults who are aged 50–64 years or without a primary care provider may further improve screening colonoscopy uptake in this community.

Acknowledgement:

We thank Amber Levanon Seligson and Nneka Lundy De La Cruz from the New York City Department of Health and Mental Hygiene for their technical assistance and review of the manuscript.

Funding:

Chau Trinh-Shevrin and Simona C. Kwon are supported by NCI Grant P30 CA 016087, NCATS Grant UL1TR001445, and CDC U48 DP006396-SIP-005. Peter S. Liang is supported by NCI Grant K08CA230162.

References

1. Miller KD, Goding Sauer A, Ortiz AP, et al.Cancer Statistics for Hispanics/Latinos, 2018. CA Cancer J Clin. 2018;68(6):425–45. [PubMed: 30285281]
2. Jackson CS, Oman M, Patel AM, Vega KJ. Health disparities in colorectal cancer among racial and ethnic minorities in the United States. J Gastrointest Oncol. 20164;7(Suppl 1):S32–43. [PubMed: 27034811]
3. Pinheiro PS, Sherman RL, Trapido EJ, et al.Cancer incidence in first generation U.S. Hispanics: Cubans, Mexicans, Puerto Ricans, and new Latinos. Cancer Epidemiol Biomarkers Prev. 20098;18(8):2162–9. [PubMed: 19661072]
4. Rastogi N, Xia Y, Inadomi JM, Kwon SC, Trinh-Shevrin C, Liang PS. Disparities in colorectal cancer screening in New York City: An analysis of the 2014 NYC Community Health Survey. Cancer Med. 20195;8(5):2572–9. [PubMed: 30843666]
5. Pinheiro PS, Callahan KE, Siegel RL, et al.Cancer Mortality in Hispanic Ethnic Groups. Cancer Epidemiol Biomarkers Prev. 2017;26(3):376–82. [PubMed: 28223429]
6. Wang Y, Rayer S. Growth Of The Puerto Rican Population In Florida And On The U.S. Mainland. Bureau of Economic and Business Research, 2018. Available at: https://www.bebr.ufl.edu/population/website-article/growth-puerto-rican-population-florida-and-usmainland#:~:text=Among%20states%2C%20New%20York%20still,%25)%20from%202010%20to%202016.AccessedFeb 17, 2020.
7. Acosta-Belen E, Rodriguez JF. Where do Puerto Ricans Live? Population by State in 2010. The Center for Puerto Rican Studies. Available at: https://centropr.hunter.cuny.edu/poster_series/images/where_do_Puerto_Ricans_Lives.pdf.AccessedFeb 17, 2020.
8. Martinez Tyson D, Medina-Ramirez P, Flores AM, Siegel R, Aguado Loi C. Unpacking Hispanic Ethnicity-Cancer Mortality Differentials Among Hispanic Subgroups in the United States, 2004–2014. Front Public Health. 2018;6:219. [PubMed: 30234082]

9. Soneji S, Armstrong K, Asch DA. Socioeconomic and physician supply determinants of racial disparities in colorectal cancer screening. J Oncol Pract. 20129;8(5):e125–134. [PubMed: 23277775]
10. Liss DT, Baker DW. Understanding current racial/ethnic disparities in colorectal cancer screening in the United States: the contribution of socioeconomic status and access to care. Am J Prev Med. 20143;46(3):228–36. [PubMed: 24512861]
11. Table SF1-P8 NYC: Total Hispanic Population by Selected Subgroups, New York City and Boroughs, 2010. New York City Department of City Planning, 2012. Available at: https://www1.nyc.gov/assets/planning/download/pdf/planning-level/nyc-population/census2010/t_sf1_p8_nyc.pdf.AccessedFeb 17, 2020.
12. New York Department of Health and Mental Hygiene. Methodology Updates to the New York City Community Health Survey. Epi Research Report.2012:1–8.
13. Shapiro JA, Seeff LC, Thompson TD, Nadel MR, Klabunde CN, Vernon SW. Colorectal cancer test use from the 2005 National Health Interview Survey. Cancer Epidemiol Biomarkers Prev. 20087;17(7):1623–30. [PubMed: 18628413]
14. Otiniano ME, Wood RC, Poursani RS, Katerndahl DA, Siddiqui S, Nadeau MT. Association of knowledge, attitudes, and behaviors for colon cancer screening in Hispanic patients. Ethn Dis. 2013;23(3):343–8. [PubMed: 23914421]
15. Sheinfeld Gorin S, Heck JE. Cancer screening among Latino subgroups in the United States. Preventive Medicine. 20055;40(5):515–26. [PubMed: 15749133]
16. Nathan TA, Cohen AD, Vinker S. A new marker of primary care utilization - annual accumulated duration of time of visits. Isr J Health Policy Res. 201712;6(1):35. [PubMed: 28793928]
17. Chung S, Romanelli RJ, Stults CD, Luft HS. Preventive visit among older adults with Medicare's introduction of Annual Wellness Visit: Closing gaps in underutilization. Preventive Medicine. 201810;115:110–8. [PubMed: 30145346]
18. Christensen K, Doblhammer G, Rau R, Vaupel JW. Ageing populations: the challenges ahead. The Lancet. 200910;374(9696):1196–208.
19. Nápoles AM, Santoyo-Olsson J, Stewart AL, et al.Physician counseling on colorectal cancer screening and receipt of screening among Latino patients. J Gen Intern Med. 20154;30(4):483–9. [PubMed: 25472506]
20. Castañeda SF, Gallo LC, Nodora J, et al.Colorectal cancer screening among Hispanics/Latinos in the HCHS/SOL sociocultural ancillary study. Prev Med Rep. 20199;15:100947. [PubMed: 31360630]
21. Klabunde CN, Meissner HI, Wooten KG, Breen N, Singleton JA. Comparing colorectal cancer screening and immunization status in older americans. Am J Prev Med. 20077;33(1):1–8. [PubMed: 17572304]
22. Hart PD, Benavidez G, Erickson J. Meeting Recommended Levels of Physical Activity in Relation to Preventive Health Behavior and Health Status Among Adults. J Prev Med Public Health. 20171;50(1):10–7. [PubMed: 28173688]
23. Wolin KY, Yan Y, Colditz GA, Lee I-M. Physical activity and colon cancer prevention: a meta-analysis. Br J Cancer. 20092;100(4):611–6. [PubMed: 19209175]
24. Boyle T, Keegel T, Bull F, Heyworth J, Fritschi L. Physical Activity and Risks of Proximal and Distal Colon Cancers: A Systematic Review and Meta-analysis. JNCI: Journal of the National Cancer Institute. 201210;104(20):1548–61. [PubMed: 22914790]
25. Itzkowitz SH, Winawer SJ, Krauskopf M, et al.New York Citywide Colon Cancer Control Coalition: A public health effort to increase colon cancer screening and address health disparities. Cancer. 20161;122(2):269–77. [PubMed: 26595055]
26. Quick Facts Colorectal Cancer (CRC) Screening in New York Behavioral Risk Factor Surveillance System - 2016. CDC, 2017. Available at: https://www.cdc.gov/cancer/ncccp/screening-rates/pdf/colorectal-cancer-screening-new-york-508.pdf.AccessedFeb 17, 2020.
27. QuickStats: Colorectal Cancer Screening Among Adults Aged 50–75 Years, by Race/Ethnicity — National Health Interview Survey, United States, 2000–2015. MMWR Morb Mortal Wkly Rep. 20169;65(38):1042. [PubMed: 27685356]

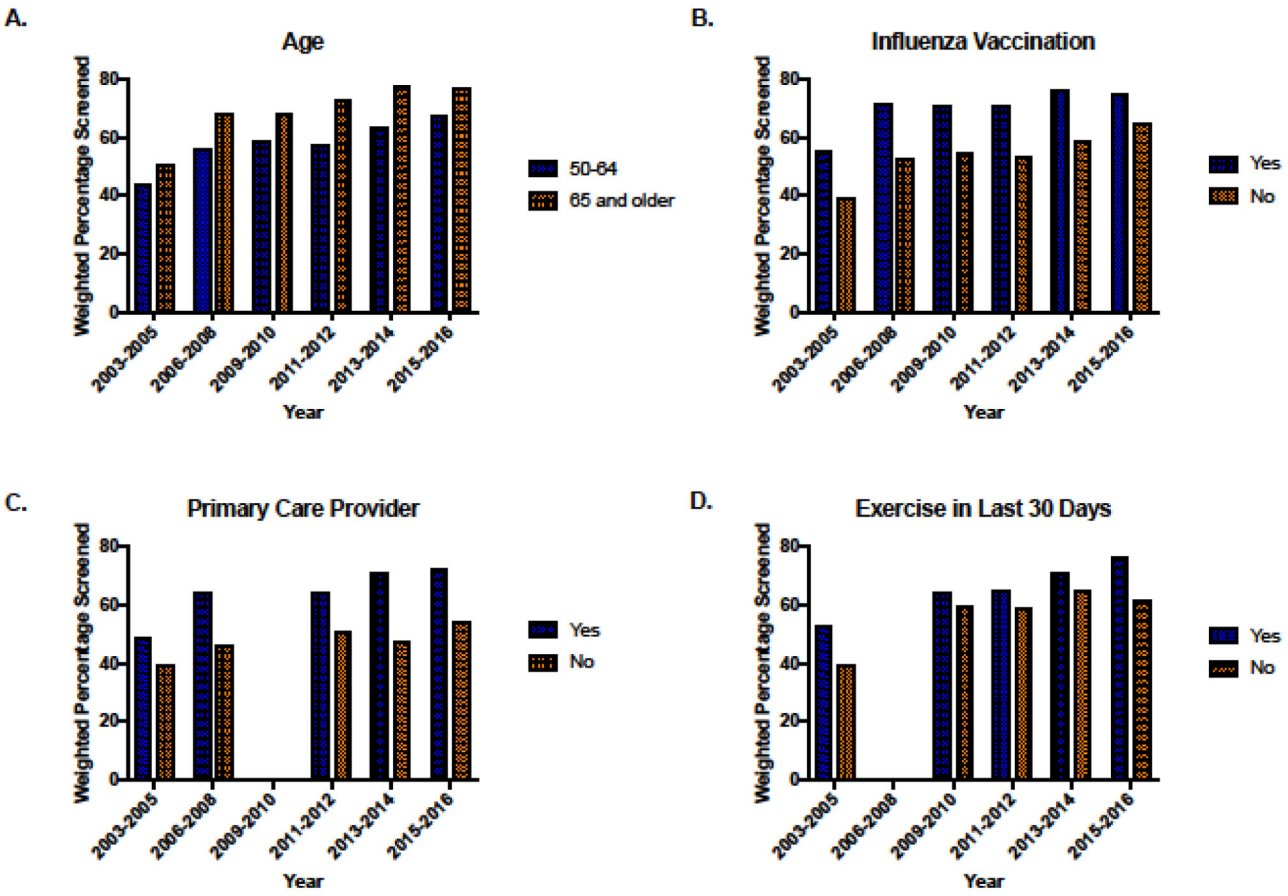

Figure 1.

Weighted percentages of up-to-date colonoscopy for age, influenza vaccination, primary care provider, and exercise

Table 1.

Up-to-date screening colonoscopy in Puerto Ricans by patient characteristics

Variable	Number screened/total and weighted percentage screened[†]											
	2003–2005		2006–2008		2009–2010		2011–2012		2013–2014		2015–2016	
All	478/994	46.5	674/1078	61.2	589/902	62.6	534/762	63.3	532/745	69.1	687/937	71.4
Age												
50–64	288/638	44.1	374/657	56.4	327/526	58.9	258/404	57.4	306/453	64.0	329/476	67.6
65 and older	190/356	50.7	300/421	68.5	262/376	68.5	276/358	72.9	226/292	78.2	358/461	77.0
Sex												
Male	147/306	45.2	184/313	59.9	163/256	60.6	165/246	57.0	171/361	65.3	196/280	69.6
Female	331/688	47.3	490/765	61.9	426/646	63.8	369/516	67.4	251/494	71.4	491/657	72.6
Home language												
English	121/239	50.4	269/468	57.5	264/403	60.9	240/362	60.3	244/351	66.5	331/469	66.2
Spanish	232/438	49.8	383/578	64.0	312/476	64.7	285/386	70.3	280/385	71.0	345/452	76.4
Education												
High school Graduate or less	363/753	46.8	482/765	61.4	393/616	64.3	367/528	61.8	365/518	68.9	432/606	70.3
Some College	68/150	43.0	107/190	55.3	108/166	56.3	94/128	71.9	102/141	66.1	137/192	69.0
College Graduate	46/89	50.4	83/121	70.2	85/117	62.6	72/104	60.8	63/84	77.7	115/135	85.9
Marital Status												
Married or partnered	115/206	52.6	204/342	61.2	177/264	64.8	131/177	71.3	152/207	71.9	205/267	72.7
Not married or partnered	255/501	49.3	465/730	61.1	410/635	61.2	400/581	59.6	379/536	67.6	479/665	70.9
Employment Status												
Employed	128/287	46.8	175/314	53.6	157/258	58.0	115/171	62.3	116/186	57.9	166/237	70.3
Unemployed	41/91	44.1	38/62	55.4	33/60	42.0	25/47	29.4	26/41	57.6	39/52	82.5
Not in Labor Force	306/609	47.1	451/688	65.2	399/583	68.6	394/542	67.3	387/515	73.9	480/644	70.8
Income Relative to Poverty Line [a]												
<200% of Poverty Line	-	-	-	-	-	-	-	-	363/502	68.8	424/597	69.3
>=200% of Poverty Line	-	-	-	-	-	-	-	-	169/243	69.8	263/340	75.9
Borough of residence												
Bronx	163/336	45.9	249/403	58.8	231/368	58.2	183/271	59.1	190/264	68.8	258/373	68.7
Brooklyn	134/294	45.9	175/287	61.0	133/188	65.8	135/184	68.6	141/218	62.4	206/265	77.4
Manhattan	118/231	49.5	149/231	62.7	139/211	61.4	150/213	62.5	120/155	75.7	125/166	72.0
Queens	55/110	47.2	73/114	67.0	60/98	68.8	47/63	68.0	52/70	77.3	73/100	67.7
Staten Island	8/23	26.5	28/43	63.0	26/37	81.1	19/31	60.1	29/38	61.3	25/33	70.2
Insurance												
Private	139/291	47.8	186/318	56.8	177/263	67.7	137/185	69.6	126/177	69.8	223/289	76.3

Variable	Number screened/total and weighted percentage screened[†]											
	2003–2005		2006–2008		2009–2010		2011–2012		2013–2014		2015–2016	
Medicare	127/239	53.1	210/302	68.6	215/313	64.6	195/266	73.9	177/234	72.1	250/327	72.2
Medicaid	157/346	45.4	185/285	65.2	130/215	60.8	137/203	52.5	178/246	70.5	175/257	71.6
Other	10/25	40.0	36/53	65.3	31/41	69.9	28/37	57.8	25/38	60.1	14/22	56.2
Uninsured	34/77	44.2	45/98	45.1	34/66	39.5	28/59	43.0	22/40	55.3	12/27	45.9
Primary care provider [b]												
Yes	384/763	49.0	574/888	64.3	-	-	495/684	64.4	498/680	71.1	644/858	73.0
No	91/221	39.8	93/179	46.2	-	-	36/73	51.1	31/60	47.7	38/72	54.6
Diabetes [c]												
Yes	-	-	209/315	68.5	188/280	71.5	185/256	71.6	203/272	70.1	261/345	73.8
No	-	-	464/761	58.1	400/621	59.5	348/505	59.3	327/471	68.3	424/588	70.4
Influenza vaccination [d]												
Yes	253/427	55.9	342/467	71.8	319/444	70.9	350/459	70.9	339/430	76.6	432/565	75.3
No	225/566	39.5	324/597	52.8	268/454	55.3	181/299	53.5	190/309	59.3	254/371	65.3
Sugar sweetened beverage (1+ SSB per day) [e]												
Yes	-	-	-	-	152/245	59.9	135/212	52.0	135/167	68.4	160/239	68.0
No	-	-	-	-	432/648	63.7	393/540	68.8	389/533	69.5	523/689	72.8
BMI												
<25	114/239	47.2	167/272	58.7	132/228	63.0	131/196	53.3	124/179	71.2	194/252	76.5
25 to <30	177/366	48.2	251/408	59.2	215/316	58.9	178/249	67.0	196/279	64.5	244/341	68.7
30+	164/337	46.0	248/380	66.1	232/342	66.1	220/309	65.7	209/281	72.4	238/328	70.3
Exercise in last 30 days [f]												
Yes	273/514	53.0	-	-	353/525	64.3	368/520	65.3	367/508	71.1	457/593	77.1
No	205/477	39.6	-	-	236/377	60.1	165/241	59.2	164/236	65.2	230/343	62.2
Tobacco [g]												
Never	-	-	124/208	59.5	328/511	63.7	296/405	69.9	311/417	72.3	382/515	73.3
Current	-	-	31/75	35.8	91/161	51.5	82/143	49.4	76/133	54.1[*]	119/174	64.1[*]
Former	-	-	67/99	68.8	166/225	71.3	152/207	64.2	143/192	73.2	183/244	73.0

[†]Number screened and total are based on survey responses. Percent screened is weighted to represent the New York City adult population.

[*]Estimate should be interpreted with caution. Estimate's relative standard error (a measure of estimate precision) is greater than 30%, the 95% confidence interval half-width is greater than 10, or the sample size is too small, making the estimate potentially unreliable.

[a]Question was not asked from 2003–2012.

[b]Question was not asked in 2010.

[c]Question was not asked in 2005.

[d] Question was asked differently over time. From 2003–2005, it was “during the past 12 months, have you had a flu shot?” From 2006 to present, it is “during the past 12 months, have you had a flu shot in your arm or a flu vaccine that was sprayed in your nose?”

[e] Question was not asked from 2003–2006.

[f] Question was not asked from 2006–2007.

[g] Data from 2003 not available for combined analysis.

Table 2.

Factors associated with up-to-date colonoscopy use among Puerto Ricans on univariable analysis

Variable	Odds Ratio (95% CI)					
	2003–2005	**2006–2008**	**2009–2010**	**2011–2012**	**2013–2014**	**2015–2016**
Age						
50–64	Ref	Ref	Ref	Ref	Ref	Ref
65 and older	1.30 (0.95–1.79)	**1.68 (1.22–2.32)**	1.52 (0.92–2.52)	**1.99 (1.15–3.45)**	**2.01 (1.25–3.23)**	**1.61 (1.01–2.55)**
Sex						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	1.09 (0.79–1.51)	1.09 (0.79–1.50)	1.15 (0.69–1.90)	1.56 (0.93–2.62)	1.32 (0.85–2.05)	1.16 (0.70–1.92)
Home language						
English	Ref	Ref	Ref	Ref	Ref	Ref
Spanish	0.98 (0.67–1.42)	1.32 (0.96–1.80)	1.18 (0.73–1.91)	1.56 (0.94–2.59)	1.23 (0.80–1.89)	**1.66 (1.05–2.61)**
Education						
High school Graduate or less	Ref	Ref	Ref	Ref	Ref	Ref
Some College	0.86 (0.56–1.31)	0.78 (0.52–1.16)	0.71 (0.38–1.33)	1.58 (0.74–3.38)	0.88 (0.51–1.53)	0.94 (0.53–1.65)
College Graduate	1.16 (0.69–1.93)	1.48 (0.90–2.43)	0.93 (0.48–1.80)	0.96 (0.47–1.97)	1.58 (0.81–3.08)	**2.56 (1.19–5.52)**
Marital status						
Married or partnered	Ref	Ref	Ref	Ref	Ref	Ref
Not married or partnered	0.87 (0.60–1.28)	1.00 (0.73–1.36)	0.85 (0.51–1.42)	0.59 (0.34–1.05)	0.82 (0.51–1.31)	0.92 (0.55–1.54)
Employment Status						
Employed	Ref	Ref	Ref	Ref	Ref	Ref
Unemployed	0.90 (0.48–1.68)	1.07 (0.54–2.15)	0.53 (0.20–1.38)	**0.25 (0.09–0.68)**	0.99 (0.42–2.33)	1.99 (0.86–4.60)
Not in Labor Force	1.01 (0.72–1.42)	**1.62 (1.16–2.26)**	1.58 (0.93–2.67)	1.25 (0.69–2.25)	**2.06 (1.27–3.35)**	1.02 (0.63–1.68)
Income Relative to Poverty Line						
<200% of Poverty Line	-	-	-	-	Ref	Ref
>=200% of Poverty Line	-	-	-	-	1.05 (0.67–1.63)	1.39 (0.86–2.26)
Borough of residence						
Bronx	0.87 (0.56–1.34)	0.85 (0.56–1.30)	0.88 (0.43–1.76)	0.87 (0.40–1.89)	0.71 (0.40–1.27)	0.85 (0.45–1.61)
Brooklyn	0.87 (0.56–1.34)	0.93 (0.60–1.46)	1.21 (0.54–2.74)	1.31 (0.57–3.04)	**0.53 (0.30–0.95)**	1.33 (0.66–2.67)
Manhattan	Ref	Ref	Ref	Ref	Ref	Ref
Queens	0.91 (0.52–1.60)	1.21 (0.69–2.11)	1.38 (0.56–3.42)	1.28 (0.44–3.67)	1.09 (0.47–2.54)	0.81 (0.28–2.32)

Variable	Odds Ratio (95% CI)					
	2003–2005	**2006–2008**	**2009–2010**	**2011–2012**	**2013–2014**	**2015–2016**
Staten Island	**0.37 (0.14–0.99)**	1.01 (0.45–2.27)	2.70 (0.83–8.74)	0.90 (0.28–2.90)	0.51 (0.17–1.57)	0.92 (0.30–2.81)
Insurance						
Private	Ref	Ref	Ref	Ref	Ref	Ref
Medicare	0.71 (0.48–1.03)	**1.66 (1.12–2.47)**	0.87 (0.48–1.56)	1.24 (0.63–2.44)	1.11 (0.60–2.06)	0.81 (0.44–1.49)
Medicaid	1.02 (0.68–1.54)	1.42 (0.95–2.14)	0.74 (0.40–1.36)	0.48 (0.23–1.01)	1.04 (0.59–1.81)	0.78 (0.47–1.31)
Other	0.52 (0.20–1.36)	1.43 (0.67–3.07)	1.11 (0.40–3.11)	0.60 (0.21–1.67)	0.65 (0.24–1.73)	0.40 (0.11–1.49)
Uninsured	0.93 (0.48–1.81)	0.62 (0.35–1.11)	**0.31 (0.12–0.80)**	**0.33 (0.13–0.83)**	0.54 (0.22–1.31)	**0.26 (0.09–0.75)**
Primary care provider						
Yes	Ref	Ref	-	Ref	Ref	Ref
No	0.69 (0.47–1.02)	**0.48 (0.32–0.72)**	-	0.58 (0.26–1.29)	**0.37 (0.19–0.73)**	**0.45 (0.21–0.97)**
Diabetes						
Yes	-	Ref	Ref	Ref	Ref	Ref
No	-	**0.64 (0.46–0.90)**	**0.59 (0.36–0.95)**	0.58 (0.33–1.00)	0.92 (0.59–1.44)	0.85 (0.51–1.40)
Influenza vaccination						
Yes	**1.94 (1.41–2.67)**	**2.27 (1.65–3.13)**	**1.97 (1.22–3.18)**	**2.12 (1.26–3.55)**	**2.25 (1.46–3.47)**	**1.62 (1.02–2.58)**
No	Ref	Ref	Ref	Ref	Ref	Ref
Sugar sweetened beverage (1+ SSB per day)						
Yes	-	-	Ref	Ref	Ref	Ref
No	-	-	1.18 (0.70–1.99)	**2.03 (1.17–3.52)**	1.05 (0.67–1.65)	1.27 (0.78–2.04)
BMI						
<25	Ref	Ref	Ref	Ref	Ref	Ref
25 to <30	1.04 (0.70–1.54)	1.02 (0.69–1.50)	0.84 (0.45–1.57)	1.78 (0.91–3.48)	0.73 (0.41–1.31)	0.68 (0.39–1.18)
30+	0.95 (0.64–1.41)	1.37 (0.92–2.04)	1.14 (0.63–2.07)	1.68 (0.90–3.12)	1.06 (0.59–1.88)	0.73 (0.41–1.28)
Exercise in last 30 days						
Yes	Ref	-	Ref	Ref	Ref	Ref
No	**0.58 (0.43–0.79)**	-	0.84 (0.52–1.35)	0.77 (0.45–1.32)	0.76 (0.49–1.18)	**0.49 (0.31–0.78)**
Tobacco						
Never	-	Ref	Ref	Ref	Ref	Ref
Current	-	**0.38 (0.20–0.72)**	0.61 (0.32–1.13)	**0.42 (0.22–0.81)**	**0.45 (0.26–0.77)**	0.65 (0.37–1.15)

Variable	Odds Ratio (95% CI)					
	2003–2005	2006–2008	2009–2010	2011–2012	2013–2014	2015–2016
Former	-	1.50 (0.78–2.90)	1.42 (0.79–2.53)	0.77 (0.42–1.43)	1.05 (0.62–1.78)	0.99 (0.56–1.75)

Table 3.

Factors associated with up-to-date colonoscopy use among Puerto Ricans on multivariable analysis

Variable	Adjusted Odds Ratio* (95% CI)					
	2003–2005	**2006–2008**	**2009–2010**	**2011–2012**	**2013–2014**	**2015–2016**
Age						
50–64	Ref	Ref	Ref	Ref	Ref	Ref
65 and older	1.35 (0.97–1.87)	**1.64 (1.15–2.33)**	1.43 (0.86–2.40)	1.50 (0.75–3.00)	**1.93 (1.16–3.19)**	**1.73 (1.08–2.77)**
Sex						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	1.24 (0.88–1.75)	0.93 (0.66–1.30)	1.03 (0.63–1.71)	1.55 (0.90–2.66)	1.27 (0.80–2.02)	1.19 (0.70–2.02)
Insurance						
Private	-	-	-	Ref	-	-
Medicare	-	-	-	0.97 (0.43–2.18)	-	-
Medicaid	-	-	-	**0.44 (0.21–0.93)**	-	-
Other	-	-	-	0.58 (0.20–1.68)	-	-
Uninsured	-	-	-	**0.29 (0.12–0.72)**	-	-
Primary care provider						
Yes	-	Ref	-	-	Ref	Ref
No	-	**0.50 (0.33–0.76)**	-	-	**0.38 (0.20–0.73)**	**0.45 (0.21–0.99)**
Influenza vaccination						
Yes	**1.91 (1.38–2.64)**	**2.17 (1.55–3.05)**	**1.86 (1.16–2.99)**	**1.86 (1.08–3.20)**	**2.02 (1.30–3.14)**	-
No	Ref	Ref	Ref	Ref	Ref	-
Sugar sweetened beverage (1+ SSB per day)						
Yes	-	-	-	Ref	-	-
No	-	-	-	**1.98 (1.13–3.46)**	-	-
Exercise in last 30 days						
Yes	Ref	-	-	-	-	Ref
No	**0.52 (0.38–0.71)**	-	-	-	-	**0.49 (0.30–0.79)**

*Multivariable logistic regression models were run separately for each time period and included age, sex, and all variables with p<0.10 on univariable analysis. Stepwise backward selection was performed until all variables (except age, sex) reached P <0.10.