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Prostate and Colorectal Cancer Screening Uptake among US and Foreign-Born Males: Evidence from the 2015 NHIS Survey

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Abstract Research suggests that prostate and colorectal cancers disproportionately affect men in the US, but little is known about the determinants of prostate-specific antigen (PSA) and colorectal cancer (CRC) screening uptake among US and foreign-born males. The purpose of this study was to investigate what factors influence prostate and colorectal cancer screening uptake among US-native born and foreign-born men. Using the 2015 National Health Interview Survey, we conducted bivariate and multivariate analyses to highlight factors associated with the uptake of prostate and colorectal cancer screening among US-native born and foreign-born men. The sample size consisted of 5651 men respondents, with the mean age of 59.7 years (SD = 12.1). Of these, more than two-fifths (42%) were aged 50–64 years old. With respect to race/ethnicity, the sample was predominantly non-Hispanic Whites (65.5%), 863 (15.6%) Hispanics, and 710 (12.4%) Blacks. Our analysis found higher rates of both US-born and foreign-born men aged 65 years or older, who had either a PSA or CRC screening tests than those aged <65 years. Results of the general multivariate model suggest that men under 50 years old, US-born and foreign-born alike, are statistically significantly less likely to have prostate or colorectal cancer screenings than men aged 65 years or above. This study highlights the influencing factors that encourage or discourage PSA and CRC screening uptake between US-native born and foreign-born men. The results of this inquiry provide an evidence-based blueprint for policymakers and interventionists seeking to address prostate and colorectal cancer among men.

Keywords Prostate · Colorectal · Cancer · Adherence · Men

Introduction

Prostate and colorectal cancers are the second and third most diagnosed cancers that affect males in the US [1–3], respectively. According to the [1], in 2016 there were approximately 180,890 new cases of prostate cancer and 134,490 new cases of colorectal cancer, including men and women [2]. Men are more likely to develop colorectal cancer as opposed to women, with 4.7% versus 4.4% [1]. In 2015, the prostate and colorectal cancer mortality rates were estimated at 9 and 8%, among males, respectively [4]. In general, a significant number of studies reported that prostate and colorectal cancer incidences vary considerably by race or ethnicity [4–6]. In particular, individuals of African descent are more likely to have prostate or colorectal cancers compared to people of European descent [5].

Research further suggests a relationship between nativity and cancer types, including prostate and colorectal cancers [7]. For example, prostate cancer incidence was more frequent among foreign-born Asian men compared to US-born Asian men [7]. When comparing the triad of Caribbean-born, African-born versus US-born Blacks, [8], noted an interesting pathway that African-born individuals were more likely to discuss early detection of prostate cancer with their physicians compared to native-born or Caribbean-born Black individuals. Early detection has been shown to increase the chances of survivorship [9].

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More than one million survivors are free of colorectal cancer due to early detection that led to appropriate treatment [1, 10]. found that Caribbean-born Blacks are less inclined to prostate-specific antigen (PSA) and colorectal cancer (CRC) screening uptake compared to US-born African-American individuals. Additionally, among high-risk persons—that is, men between 50 and 59 years old—uptake of CRC screening is significantly less [11]. Similarly, in a study conducted in Europe, [12] found that White people were more likely to adhere to PSA recommendations than other racial or ethnic groups.

Consistently, research has shown that healthcare access acts as a *sine qua non factor* in determining screening uptake in regards to PSA and CRC screening [13–16]. According to the [17], cancer screening uptake is defined as "the percentage of people who have been sent an invitation for screening, attend and undergo screening in response to that invitation". Overall, there is a dearth of studies that focus on understanding prostate and colorectal cancer screening adherence among men in the US, and differences by nativity. In this study, we aim to investigate predictors involved in prostate and colorectal cancer screening adherence by nativity and residence in the US. In doing so, we hope to gain knowledge on determinants that play a crucial role in prostate and colorectal cancer screening uptake among men. Further, we examine if there are significant differences in prostate and colorectal cancer screening among US males by nativity as a proximate determinant of cancer screening uptake while controlling for other covariates.

Methods

Data

This cross-sectional study uses data from the 2015 National Health Interview Survey. Briefly, the NHIS survey comprises a complex multistage national probability design that provides a representative sample of US households and civilian adults from all 50 states and the District of Columbia. The NHIS is conducted annually by the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention (CDC). The procedures involved in the NHIS and details concerning its sample design can be found in "NHIS Survey Description-2015 Public Use Data Release" [18].

Samples Size

Analytic sample consisted of 5651 males 40 years or older from the 2015 National Health Interview Survey (NHIS) who had no missing information on the considered covariates.

Outcome Variables

Prostate cancer screening (PSA) and colorectal cancer (CRC) screening specifically colonoscopy (COL) or sigmoidoscopy (SIG) among participants aged 40 years or older. We created a variable called "sigcol" for the two standard tests used for colon and rectal cancer screening, in which "sigcol = 1" if either 'sighad = 1' or 'colhad = 1'.

Predictor Variables

In addition to demographic variables, place of birth, socio-economic status, and family history of prostate cancer or colorectal cancer were incorporated as independent variables.

Analysis

All analyses applied sampling weights and adjusted for clustering and stratification of observations. Potential confounders were controlled for in the multivariate logistic regression model. The study identified factors associated with the uptake of prostate and colorectal cancer screening among US-native born and foreign-born men using adjusted multivariate logistic regression model. Additionally, factors affecting prostate and colorectal cancer screening were identified for cases where a family history of cancer existed.

Descriptive results are reported as percentages and frequencies. We further, tested bivariate associations using Chi square test of independence, between demographic and socio-economic factors and both cancer types screening. The Bivariate analyses were reported as proportions and significance levels while the multivariate results are reported as odds ratios with 95% confidence intervals and significance levels. The minimum significance level is set at ($p < 0.05$). All analyses were conducted using Stata/SE version 14 software. Stata allows for a design-based analysis for complex survey sample (applies sampling weights and adjusted for clustering and stratification of observations) such as the NHIS survey data. This controls for the skewness of the standard errors, which affects the significance levels.

Results

Findings from this analysis are presented in three stages: first descriptive analysis with means and standard deviation

for continuous variables (age) and weighted proportions for other covariates as well as the distribution of the two measures of access and utilization (Table 1). Table 2 presents χ^2 proportions for cancer screening in general, and Table 3 presents adjusted odds ratios for cancers screening by place of birth in the general multivariable model. Table 4 displays adjusted odds ratios (95% CI) of male cancer screening when there is a family history of cancer.

Descriptive Analysis

Table 1 includes the distribution of the two measures of access and services utilization that is having a regular source of care, and actual visitation to a general physician in the 12-month period preceding the survey. The sample size consisted of 5651 men respondents, with the mean age of 59.7 years (SD = 12.1). Of these, more than two-fifths (42%) were aged 50–64 years old. With respect to race/ethnicity, the sample was predominantly non-Hispanic Whites (65.5%), 863 (15.6%) Hispanics, and 710 (12.4%) Blacks. Approximately 54% of the sample had less than a college degree compared to 30% with a Bachelor's degree and less that 1% with masters or doctoral degrees. More than half of the men (59%) were married or living with a partner in the same household; compared to more than two-fifths (41%) who were unmarried. The results also indicated that more than half of men (55.7%) were employed, and one-third (34%) earned an annual family income of <$35,000.

Approximately 52% of the men reported being in excellent or very good health condition compared to 43% in good health and 5% in poor health condition. With respect to family health history, about 25.3 and 23.4% respondents had a father or mother with any type of cancer, respectively. Likewise, 15.4 and 17.5% of the respondents had a brother or sister with a history of cancer, respectively. An estimated 49.8% ever had a PSA test compared to 48.2% who had a colonoscopy, and 6.9% who reported having a sigmoidoscopy. For the next level of analysis, we combined the two colorectal test in one variable "sigcol" in which yes = 1 and represented whose who had either or the two test, and no = 0 where neither test was received.

We further examined the distribution of the two measures of health care access and utilization; namely, having a regular source of care, and having a doctor visit in the 12-month period preceding the interview. Bivariate results are presented in Table 1 above. Results suggest that alcohol use was significantly associated with having a regular source of care ($\chi^2 = 19.96$, $p < 0.01$). In particular, more men (91.2%) who had a past history of alcohol drinking behavior had a regular source of care compared to men who currently (86.8%) or never drink alcohol (89.8%). Similarly, there was a significant association between self-reported health status and regular source of care ($\chi^2 = 16.87$, $p < 0.01$). We found a higher percentage of men who reported being in poor health condition (92.7%) than those in good/fair (89.5%) or excellent/very good health condition (86.6%). In general, findings suggest a significant relationship between having a regular source of care among males and cancer screening tests like PSA or CRC screening ($\chi^2 = 283.86$, $p < 0.0001$; $\chi^2 = 416.58$, $p < 0.0001$; $\chi^2 = 26.76$, $p < 0.01$), respectively. That is, more men who had taken a screening test had a regular source of care compared to men who had not, whether that was a PSA test (95.4% vs. 80.9%), a COL test (96.6% vs. 79.1%), or a SIG test (96.3% vs. 87.5%), respectively. Likewise, family history of any cancer types was significantly associated with doctor visit in the last 12 months ($\chi^2 = 61.43$, $p < 0.0001$). Overall, there were more men, with a family history of cancer, who had seen a doctor in the last 12 months than men who did not. We also found a significant relationship between the region where men resided and doctor visit in the last 12 months ($\chi^2 = 61.43$, $p < 0.0001$). In particular, more men residing in the US Northeast area (78.2%) visited a doctor in the last 12 months compared to those residing in the Midwest (75.6%), in the South (75%), and in the West (66%) geographic areas.

Bivariate Results

The weighted bivariate proportions for prostate and colorectal cancer screenings are reported in Table 2. Our analysis found higher rates of both US-born and foreign-born men aged 65 years or older, who had either a PSA or CRC screening tests than those aged <65 years. The results show significant relationships between age and PSA for both US ($\chi^2 = 676.68$, $p < 0.0001$) and foreign-born men ($\chi^2 = 121.68$; p value <0.0001); and CRC screening among US-born men ($\chi^2 = 802.65$, p value <0.0001) and foreign-born men ($\chi^2 = 226.56$ $p < 0.0001$), respectively. Race was also significantly associated with the proportions of both prostate and colorectal cancer screenings among US and foreign-born men ($\chi^2 = 43.08$, $p < 0.01$; $\chi^2 = 38.86$, $p < 0.0001$), respectively. The results suggest that white males, regardless of nativity, had higher rates of PSA testing than any other racial groups. A similar significant association was observed between race and nativity in terms of CRC screening ($\chi^2 = 40.38$, $p < 0.0001$; $\chi^2 = 41.38$, $p < 0.0001$), with a higher percentage of white males who had colorectal cancer screening compared to other racial and ethnic groups. There were more US-born men with a family history of cancer, defined as cancer of any kind, who had a PSA test compared to US-born men who did not have a family history of cancer. This pattern held for foreign-born men as well. Of those men, regardless of nativity, who had colorectal cancer screening, there was a

Table 1 Characteristics associated with regular source of care and recent doctor visit in last 12 months

Independent variables	Sample characteristics		Have a regular source of care (n = 4990)		Seen a doctor in last 12 months (n = 4990)	
	Count	Weighted (%)	Weighted (yes %)	χ^2	Weighted (yes %)	χ^2
Age (mean = 59.7; SD = 12.1)				203.26***		
40–49	1335	23.6	78.81		58.46	261.19***
50–64	2367	42	87.66		72.45	
>65	1949	34.4	95.16		83.91	
Race/ethnicity						
White	3713	65.5	89.93	91.59***	76.76	113.34***
Hispanic	863	15.6	78.69		59.34	
Black/African-American	710	12.4	90.67		72.95	
Asian	307	5.5	88.58		70.19	
Others	58	1.0	84.52		64.29	
Education				42.26***		
High school or less	931	16.5	83.29		67.02	31.87***
Associate degree	3026	53.6	88.13		72.87	
Bachelor	1678	29.6	91.1		76.99	
Graduate school	16	0.3	67.86		60.71	
Marital Status						
Married	3330	59	90.29	35.82***	75.13	17.22**
Separated/widowed/single	2321	41	85.06		70.15	
Employment status						
Not employed	2514	44.3	92.05	65.58***	81.19	50.36***
Employed	3137	55.7	85.04		66.63	
Family income						
<35,000	1920	34	83.54	73.43***	69.44	33.16***
35,000–74,999	1780	32	88.51		72.0.36	
75,000–99,999	643	11	91.91		75.74	
100,000 and more	1308	23	92.67		78.22	
Insurance						
Yes	5098	90.2	92.17	806.82***	77.41	494.77***
No	533	9.8	51.08		33.25	
Have a regular source of care						
Yes	4990	88.1	–	–	–	–
No	661	11.9				
Alcohol use						
Never drink	726	12.8	89.84	19.96**	71.25	17.28**
Former drinker	1240	22	91.23		77.68	
Current drinker	3685	65.2	86.77		71.89	
General health status						
Excellent/very good	2924	51.6	86.57	16.87**	67.49	106.76***
Good/fair	2429	43.1	89.49		78.07	
Poor	298	5.3	92.65		87.08	
Biological father had cancer of any kind						
Yes	1415	25.3	90.26	8.18*	76.26	9.79**
No	4236	74.7	87.43		72.02	
Biological mother had cancer of any kind						
Yes	1336	23.4	89.26	2.05	75.67	5.89*
No	4315	76.6	87.81		72.29	

Table 1 (continued)

Independent variables	Sample characteristics		Have a regular source of care (n = 4990)		Seen a doctor in last 12 months (n = 4990)	
	Count	Weighted (%)	Weighted (yes %)	χ^2	Weighted (yes %)	χ^2
Biological brother had cancer of any kind						
Yes	874	15.4	92.69	20.39***	81.06	0.27***
No	4777	84.6	87.32		71.64	
Biological sister had cancer of any kind						
Yes	728	17.5	92.24	15.19**	80.93	31.93***
No	3419	82.5	87.06		70.62	
Number of biological brothers had cancer of any kind						
None	4777	84.6	87.32	21.31**	71.64	33.84***
One	743	13.1	93.02		81.31	
Two or more	97	1.7	89.79		78.23	
Three or more	34	0.6	94		84	
Had a PSA						
Yes	2820	49.8	95.41	283.86***	85.41	432.92***
No	2831	50.2	80.93		60.85	
Had a colonoscopy						
Yes	2952	48.2	96.61	416.58***	85.15	449.77***
No	2699	51.8	79.05		60.11	
Had a sigmoidoscopy						
Yes	399	6.9	96.29	26.76***	87.69	45.71***
No	5252	93.1	87.54		71.99	
Region						
Northeast	944	16.6	90.64	17.23**	78.18	61.43***
Midwest	1216	22	89.07		75.55	
South	1867	33	88.52		75.04	
West	1624	28.4	85.55		65.95	

Significance levels: ***p value < 0.0001; **p value < 0.01; *p value < 0.05

higher percentage with a family history of any types of cancer than those without a family history of cancer.

Having health insurance was significantly associated with prostate and colorectal cancer screening in our study by nativity. Specifically, more men with health insurance were cancer screened regardless of nativity. Comparably, there was a significant association between seeing a doctor in the 12 months before the survey and having a PSA or CRC tests, regardless of birthplace (See Table 2).

Overall, despite public health messages and efforts to increase screenings, results of the general multivariate model suggest that men under 50 years old, US-born and foreign-born alike, are statistically significantly less likely to have prostate or colorectal cancer screenings than men aged 65 years or above (Table 3). For instance, US-born men aged 40–49 and 50–64 were significantly less likely to have a PSA test compared to men aged 65 and older [OR_{adj} 0.09, (CI 0.07–0.11), and OR_{adj} 0.41, (CI 0.35–0.49)], respectively. Among foreign-born men, only those aged 40–49 years were significantly less likely to have a PSA test compared to foreign-born men aged 65 years or older [OR_{adj} 0.28, (CI 0.17–0.45)].

With respect to education, both US-born and foreign-born men with a bachelor degree were more likely to have a PSA test compared to those with only a high school diploma or less [OR_{adj} 2.58, (CI 1.96–3.38); OR_{adj} 1.97, (CI 1.24–3.13)], respectively. Moreover, both US-born and foreign-born men who had seen a doctor in the last 12 months were more likely to have had a PSA test than their counterparts who had not [OR_{adj} 2.30, (CI 1.86–2.86), and OR_{adj} 2.36, (CI 1.58–3.53)], respectively. Surprisingly, US-born men living in the South were more likely to have had a PSA test than US-born men living in the Northeast geographic areas of the US [OR_{adj} 1.29, (CI 1.06–1.57)].

While the specific measures vary, the patterns noted above for PSA tests repeat exactly for colorectal cancer screening. Men younger than 65 years and educational levels less than a bachelor's degree all show significantly less likelihood of having had colorectal cancer screening. For both US and foreign-born men, having seen a doctor in the

Table 2 Weighted proportions of prostate and colorectal cancer screening in US and foreign-born men

Independent variables	Prostate cancer screening (PSA)				Colorectal cancer screening using sigmoidoscopy or colonoscopy			
	US born		Foreign born		US born		Foreign born	
	Yes %	χ^2	Yes %	χ^2	Yes %	χ^2	Yes %	χ^2
Age								
40–49	20.56	676.68***	15.01	121.68***	20.19	802.65***	8.27	226.56***
50–64	53.03		34.79		58.87		40.72	
>65	73.94		54.72		77.83		61.50	
Race/ethnicity								
White	56.31	43.08**	50	38.86***	59.90	40.38***	53.70	41.38***
Hispanic	39.22		29.15		41.46		26.98	
Black/African-American	51.15		45.83		56.49		31.25	
Asian	33.94		23.90		53.21		39.01	
Others	47.22		25		38.89		33.33	
Education								
High school or less	46.15	65.66***	26.59	31.45***	51.17	46.18***	24.04	33.49***
Associate degree	51.60		27.49		55.92		33.08	
Bachelor	62.95		44.51		65.40		44.72	
Graduate school	33.33		30.77		53.33		15.38	
Marital status								
Married	59.20	58.20***	31	0.26	61.61	29.11***	34.33	1.08
Separated/widowed/single	47.82		32.53		53.63		31.18	
Employment status								
Not employed	63.20	130.43***	48.57	67.69***	68.40	175.47***	48.92	59.07***
Employed	46.28		24.02		48.97		25.76	
Family income								
<35,000	48.77	33.08***	28.43	14.47**	53.38	20.09**	27.61	18.88**
35,000–74,999	54.50		32.09		60.70		34.58	
75,000–99,999	60.61		27.74		60.12		34.31	
100,000 and more	58.08		43.42		60.15		45.20	
Insurance								
Yes	56.31	97.85***	36.66	42.87***	60.79	167.29***	39.16	66.88***
No	27.96		13.87		24.08		10.40	
Have a regular source of care								
Yes	57.62	188.41***	37.32	56.45***	62.44	315.39***	39.44	74.28***
No	23.47		11.08		18.68		9.04	
Have seen a doctor in last 12 months								
Yes	61.11	274.89***	43.63	104.11***	65.20	297.66***	45.87	119.36***
No	32.28		14.45		35.49		14.31	
Alcohol use								
Never drink	52.21	14.96**	27.54	5.56	57.83	16.17**	35.36	5.16
Former drinker	59.47		38.26		63.45		39.26	
Current drinker	52.79		31.77		56.34		31.02	
Smoking status								
Yes	55.68	4.21	34.59	2.39	59.85	6.25*	37.38	5.93*
No	52.64		30.20		56.18		30.40	
General health status								
Excellent/very good	54.31	0.45	27.73	12.89**	55.79	12.32**	30.09	7.78*
Good/fair	54.50		35.15		61.11		35.52	
Poor	52.25		48.61		57.82		47.22	

Table 2 (continued)

Independent variables	Prostate cancer screening (PSA)				Colorectal cancer screening using sigmoidoscopy or colonoscopy			
	US born		Foreign born		US born		Foreign born	
	Yes %	χ^2	Yes %	χ^2	Yes %	χ^2	Yes %	χ^2
Biological father had cancer of any kind								
Yes	61.92	42.88***	43.35	8.81**	64.18	27.11***	42.86	6.13*
No	51.21		30.52		55.74		32.05	
Biological sister had cancer of any kind								
Yes	62.99	18.69***	42.86	6.19*	70.93	42.20***	48.41	8.47*
No	53.54		29.58		56.92		32.49	
Biological mother had cancer of any kind								
Yes	56.80	4.19	45.83	12.30**	62.87	14.98**	41.15	3.87
No	53.37		30.30		56.45		32.34	
Biological brother had cancer of any kind								
Yes	69.55	90.17***	55.28	21.42**	73.91	97.87***	61.79	31.46***
No	51.05		30.24		54.82		31.12	
Region								
Northeast	54.40	8.53	40.12	11.89*	63.37	12.19*	45.59	20.67**
Midwest	52.26		30		57.82		32.67	
South	57.17		33.62		58.15		32.93	
West	52.45		27.06		55.27		27.68	

Significance levels: ***p value <0.0001; **p value <0.01; *p value <0.05

preceding 12 months was associated with higher odds of having either a colorectal cancer screening than men who did not have a doctor visit in the same time frame. Additionally, we found that US-born and foreign-born men with a regular source of care were significantly more likely to have one or the other colorectal cancer screening tests [OR_{adj} 3.63 (CI 2.65–4.97); OR_{adj} 2.39 (CI 1.31–4.37)], respectively.

As shown in Table 4, many of these general trends continue to persist at the multivariable level. For instance, when stratified by family history of cancer, we found that US-born men aged <50 years were less likely to have a PSA test compared to US-born men aged 65 years or older [OR_{adj} 0.57 (CI 0.39–0.89)]. Furthermore, US-born and foreign-born Blacks/African Americans were less likely to have had a PSA test than US-born or foreign-born Whites [OR_{adj} 0.59 (CI 0.45–0.79); OR_{adj} 0.22 (0.08–0.62)]. In general, for US-born men with a family history of any cancer types, those living in the South or West were less likely to have a PSA test compared to those living in the Northeast [OR_{adj} 0.69 (CI 0.54–0.88); OR_{adj} 0.73 (CI 0.57–0.95)], respectively.

Consistent with the above, we found that US-born or foreign-born Black, Hispanic, and Asian men with a family history of cancer were less likely to have had a colorectal cancer screening than US-born or foreign Whites (see Table 4). In addition, both US and foreign-born men who listed health problems as the reason for a doctor visit were less likely to have a colorectal screening than those who reported routine screening as their reason [OR_{adj} 0.13 (CI 0.11–0.16); OR_{adj}= 0.06 (CI 0.04–0.11)], respectively. As expected, all men with a family history of cancer who reported poor health status were more likely to have had a colorectal cancer screening compared to US-born and foreign-born men who reported their health as excellent or very good [OR_{adj} 1.44 (CI 1.03–2.03) and OR_{adj} 3.44 (CI 1.08–10.94)], respectively. Likewise, both US- and foreign-born men with a family history of cancer who had seen a doctor in the last 12 months were more likely to get a colorectal cancer screening compared to those who did not see a doctor in the last 12 months.

Discussion

In this nationally representative sample, we focused on understanding factors that contribute to PSA and CRC screening uptake among men in the US. One of the principal findings relates to healthcare access, specifically that men aged 65 years or older were more likely to have a regular source of care compared to men aged 64 years or less. This increased likelihood is consistent with findings by

Table 3 Adjusted odds ratio for PSA and CRC cancer screenings by nativity

Independent variables	Prostate cancer screening (PSA)				Colorectal cancer screening using sigmoidoscopy or colonoscopy			
	US born men		Foreign born men		US born men		Foreign born men	
	OR_{adj}	95% CI	OR_{adj}	95% CI	OR_{adj}	95% CI	OR_{adj}	95% CI
Age								
40–49	0.09***	0.07–0.11	0.28***	0.17–0.45	0.08***	0.06–0.10	0.07***	0.04–0.13
50–64	0.41***	0.35–0.49	0.70	0.45–1.09	0.48***	0.40-.0.57	0.56*	0.35–0.89
>65 (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Education								
High school or less (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Associate degree	1.62***	1.30–2.03	0.99	0.67-1.45	1.68***	1.36–2.09	1.55*	1.03–2.32
Bachelor	2.58***	1.96–3.38	1.97**	1.24–3.13	2.66***	2.06–3.43	2.28**	1.39–3.72
Graduate school	0.98	0.21-4.66	0.99	0.19–5.20	2.56	0.65–10.12	0.35	0.04–2.81
Marital status								
Separated/widowed/single (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Married	1.33***	1.13–1.54	0.93	0.66–1.32	1.15	0.98–1.34	0.98	0.65–1.46
Employment status								
Not employed (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Employed	0.78**	0.66–0.93	0.54**	0.37–0.78	0.70**	0.57-0.86	0.78	0.52–1.17
Family income								
<35,000 (ref)	1.00	–	1.00	–	1.00	–	1.00	–
35,000–74,999	1.22*	1.00-1.48	1.52	0.99–2.34	1.44***	1.18–1.76	2.14**	1.39–3.28
75,000–99,999	1.71***	1.33–2.20	1.35	0.77–2.35	1.49**	1.13–1.99	2.16*	1.09–4.27
100,000 and more	1.64***	1.26–2.12	1.93*	1.08–3.46	1.71***	1.30–2.26	2.89**	1.56–5.33
Insurance								
No (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Yes	1.01	0.76–1.35	1.07	0.61–1.89	1.52*	1.09–2.11	1.31	0.64–2.69
Have a regular source of care								
No (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Yes	1.98***	1.41–2.77	1.99*	1.12–3.55	3.63***	2.65–4.97	2.39**	1.31–4.37
General health status								
Excellent/very good (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Good/fair	0.86	0.73–1.01	1.26	0.86–1.84	1.09	0.93–1.29	1.11	0.76–1.62
Poor	0.81	0.59–1.10	1.33	0.61–2.88	0.97	0.66–1.42	1.15	0.50–2.67
Have seen a doctor in last 12 months								
No (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Yes	2.30***	1.86–2.86	2.36***	1.58–3.53	1.94***	1.58–2.39	2.55***	1.65–3.96
Alcohol use								
Never drink (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Former drinker	1.30	0.97–1.75	1.49	0.92–2.41	1.15	0.86–1.53	0.95	0.48–1.86
Current drinker	1.13	0.91–1.42	1.46	0.95–2.26	1.05	0.80–1.36	0.76	0.44–1.32
Smoking status								
No (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Yes	1.09	0.93–1.27	1.06	0.76–1.46	1.07	0.91–1.25	1.41	0.99–1.99
Region								
Northeast (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Midwest	1.01	0.83–1.24	0.76	0.40–1.45	0.85	0.65–1.11	0.71	0.37–1.35
South	1.29*	1.06–1.57	0.83	0.49–1.39	0.82	0.63–1.06	0.62	0.38–1.01
West	0.98	0.81–1.17	0.68	0.39–1.17	0.71*	0.55–0.92	0.59*	0.37–0.94

Significance levels: ***p value <0.0001; **p value <0.01; *p value <0.05

Table 4 Adjusted odds ratios of male cancer screening when there is a family history of cancer

Independent variables	Prostate cancer screening when biological father, mother or siblings have history of any cancer type				Colorectal cancer screening when biological father, mother, or siblings have history of any cancer type			
	US born		Foreign born		US born		Foreign born	
	OR_{adj}	95% CI	OR_{adj}	95% CI	OR_{adj}	95% CI	OR_{adj}	95% CI
Age								
40–49	0.57**	0.39–0.84	0.61	0.26–1.41	0.34***	0.24–0.48	0.28**	0.13–0.59
50–64	0.89	0.74–1.09	0.75	0.39–1.42	0.88	0.73–1.07	0.75	0.40–1.38
>65 (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Race/ethnicity								
White (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Hispanic	0.52**	0.32–0.85	0.50	0.24–1.03	0.56**	0.36–0.87	0.48*	0.26–0.88
Black/African-American	0.59***	0.45–0.79	0.22**	0.08–0.62	0.55***	0.43–0.69	0.24**	0.09–0.68
Asian	0.55	0.29–1.03	0.13***	0.05–0.33	0.71*	0.51–0.99	0.19***	0.09–0.39
Others	0.79	0.33–1.89	0.15	0.01–18.59	0.69	0.37–1.33	0.63	0.02–18.90
Education								
High school or less (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Associate degree	1.29	0.93–1.79	1.00	0.48–2.11	1.40*	1.08–1.82	0.99	0.54–1.80
Bachelor	1.31	0.93–1.86	1.44	0.66–3.14	1.65**	1.23–2.22	1.11	0.56–2.21
Graduate school	0.23	0.03–1.97	1.27	0.09–17.08	0.18	0.02-2.00	2.75	0.50–15.10
Marital status								
Separated/widowed/single (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Married	1.03	0.83–1.26	0.96	0.55–1.70	1.09	0.93–1.29	1.45	0.89–2.36
Employment status								
Not employed (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Employed	0.98	0.78–1.22	1.22	0.63–2.38	0.89	0.74–1.07	1.75	0.86–3.55
Family income								
<35,000 (ref)	1.00	–	1.00	–	1.00	–	1.00	–
35,000–74,999	1.14	0.89–1.45	1.09	0.57–2.10	1.11	0.90–1.37	1.26	0.67–2.37
75,000–99,999	1.38	0.98–1.97	2.68	0.98–7.37	1.19	0.86–1.64	1.37	0.56–3.35
100,000 and more	1.19	0.89–1.59	2.90*	1.22–6.90	1.14	0.86–1.49	1.72	0.80–3.68
Reason for screening								
Health problem	1.39*	1.07–1.83	0.67	0.34–1.35	0.13***	0.11–0.16	0.06***	0.04–0.11
Routine exam (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Person who suggested PSA screening								
Self (ref)	1.02	0.76–1.38	0.85	0.48–1.50	–	–	–	–
Doctor	1.14	0.67–1.94	0.62	0.10–3.78				
Someone else	1.00	–	1.00	–				
Have a regular source of care								
No (ref)	1.00							
Yes	1.25	0.79–1.97	0.75	0.28–2.03	1.97***	1.41–2.76	1.28	0.46–3.52
General health status								
Excellent/very good (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Good/fair	1.16	0.92–1.45	1.32	0.76–2.30	1.19	0.99–1.44	1.44	0.86–2.41
Poor	1.47	0.94–2.31	2.06	0.66–6.48	1.44*	1.03–2.03	3.44*	1.08–10.94
Have seen a doctor in last 12 months								
No (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Yes	1.11	1.45	1.36	0.62–2.99	1.31*	1.05–1.64	2.19*	1.12–4.26
Alcohol use								
Never drink (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Former drinker	1.22	0.84–1.78	1.48	0.59–3.72	1.33	0.97–1.83	1.38	0.65–2.96

Table 4 (continued)

Independent variables	Prostate cancer screening when biological father, mother or siblings have history of any cancer type				Colorectal cancer screening when biological father, mother, or siblings have history of any cancer type			
	US born		Foreign born		US born		Foreign born	
	OR_{adj}	95% CI	OR_{adj}	95% CI	OR_{adj}	95% CI	OR_{adj}	95% CI
Current drinker	1.09	0.78–1.53	1.65	0.77–3.55	1.19	0.92–1.54	1.32	0.72–2.45
Smoking status								
No (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Yes	1.13	0.91–1.39	0.77	0.44–1.37	1.03	0.87–1.22	0.97	0.60–1.57
Region								
Northeast (ref)	1.00	–	1.00	–	1.00	–	1.00	–
Midwest	0.95	0.74–1.21	0.87	0.35–2.18	1.05	0.87–1.26	1.62	0.68–3.83
South	0.69**	0.54–0.88	0.78	0.41–1.51	0.91	0.74–1.10	1.23	0.69–2.20
West	0.73*	0.57–0.95	0.85	0.47–1.54	0.79*	0.66–0.96	0.93	0.54–1.60

Significance levels: ***p value <0.0001; **p value <0.01; *p value <0.05

[19], who reported that older patients with health chronic ailments were more prone to have a usual source of care compared to those who did not have any chronic diseases.

This greater *frequency* of healthcare access resonates our finding that men in self-perceived poorer health and those who had seen a doctor in the preceding 12 months were more likely to have had PSA or CRC screening tests than those self-perceived as in fair or excellent health. Other factors that increased frequency of healthcare access included former drinkers who were more likely to have a regular source of care and to have seen a doctor in the last 12 months, men with a family history of any cancer types who had seen a doctor in the last 12 months, and being Whites, regardless of nativity, who have seen a doctor in the last 12 months.

While people of Black descent were the most likely to have a regular source of care compared to other racial or ethnic groups in the US, this source of care did not necessarily mean seeing a doctor or having access to screening tests; again, people of White ethnicity (foreign-born or not) rather were the most likely to have visited a doctor in the last 12 months. If people of Black descent are most likely to have a regular source of care and yet remain less likely to get PSA or CRC tests, then this exposes a gap in preventative care that needs closing.

In general, being older, aged 65 and older, was positively associated with the probability of having a prostate and colorectal cancer screening. Drazer et al. [20] who reported that prostate screening rate steadily increases with age, that is from 24% for men aged 50–54 years up to 46% for men aged 70–74 years. Indeed, prostate cancer screening becomes a frequent medical plan as men age, at least among those with a regular source of care. This stresses the importance of increasing screening uptake among men earlier in their lives, especially as they approach their 40 s and are at higher risk for developing prostate or colorectal cancer [21].

Disambiguating the sample by nativity yielded clear distinctions around the prostate and colorectal cancer screening distribution. For example, US-born and foreign-born Whites showed a higher probability of PSA or CRC screening compared to other US-born or foreign-born racial and ethnic groups [20], similarly found that foreign-born men were less likely than US-born men to have had PSA tests [22] also found that Whites were more likely to have had colorectal cancer screening than Asians.

We found that all men, whether US-born or foreign-born, with an immediately family history of cancer, were more likely to have had a PSA or CRC screening tests than men who had no such immediate family history. This is consistent with [23], who found that a family history of cancer like CRC or breast cancer positively associated with other relatives having cancer screenings. That is, having at least one affected first-degree relative with CRC substantially increases the likelihood of developing same cancer [23]. While having an immediate family member with a cancer diagnosis has been documented to suggest increased risk, for indices. Consequently, public health and primary care professionals must stress the need for screening and to allow for early detection and treatment of at-risk individuals with the familial history of cancer.

We found that having a regular source of care, having seen a doctor in the 12 months preceding the interview, and age were strong predictors of prostate and colorectal screening for US-born or foreign-born men alike. Since men younger than 65 years were less likely to report uptake of PSA and CRC screening, we surmise simply that the greater likelihood of having access healthcare from age

65 years onward serves to increase screening for that age. Similarly, any condition or preventative check-up that leads one to see a doctor, whatever the reason for the visit, seems to increase the likelihood of both PSA and CRC screening uptake. It seems medically preferable, however, not to wait until some health issue brings a man to the clinic or ambulatory facility, especially since prostate and CRC are both readily preventable and treatable if detected early.

Moreover, prostate and colorectal cancer screening are considerably more likely at the intersection of education and income. Consequently, socioeconomic and educational poverty make screening less likely. It is not clear from the literature base, if simply more health education, defined as knowledge, or more enabling resources such as health insurance, free time, improved health infrastructures in socioeconomically advantaged neighborhoods plays the lead role here. Whereas Black/African Americans have the most access to a regular source of care, they still had a lower likelihood of PSA or CRC screenings. Worse still, the fact that Black men with a family history of cancer, born in the United States or not, are less likely to have prostate and colorectal cancer screening compared to White men with or without a family history of cancer underscores an ongoing disparity of access to treatment despite efforts to improve the quality of life of all Americans and eliminate disparities. Because of these factors, we recommend a comprehensive cancer control initiative for men [24]. This initiative should include education and outreach that support healthy behaviors. Policies to continuously monitor incidence rates of men's cancers in conjunction with age [25] are key to avoiding missed opportunities for early detection and decreasing mortality rates.

Conclusion

Prostate and colorectal cancers are among the most prevalent cancerous diseases in the US, and also the most preventable and treatable. Examining factors contributing to prostate and colorectal cancer screening uptake among US men, observed trends were informed by an array of factors like age, education, employment, an immediately family history of cancer, having a regular source of healthcare, and having seen a doctor in the last 12 months. While lower age was associated with a lower likelihood of PSA or CRC screening in general—suggesting that *all* men in the United States, foreign-born or not, would benefit from a greater motivation to seek out testing sooner rather than later in life.

These findings paint a consistent pattern of decreased likelihood for all three types of screening for less socioeconomically advantaged men, whether in terms of education, income, or non-white ethnicity, even when otherwise having regular access to care. While poorer health states that instigated a greater *frequency* of access to healthcare—whether due to a history of former drinking, to a self-perceived sense of poor health, simply due to advancing age, or other similar factors—did associate with a greater likelihood of screening, disparities remained. However, none of these factors yielded a greater likelihood of screening for non-Whites compared to Whites in the same categories. Non-Whites, particularly people of African descent, with an immediate family history of cancer still experience lower likelihood of screening. Or to put it another way, while men in general who had taken a screening test were more likely to have a regular source of care compared to men who had not, Black men with a regular source of care nonetheless had a lower likelihood of testing. Limitations of this study include the following. The study uses secondary analysis; we are beholden to the available data without knowing how that dataset was collected. Additionally, different ways of measuring the same item could have introduced inconsistencies into the dataset. These limitations, however, are no more severe or unusual than in any secondary study. Nonetheless, the very effort of this study was to capture and maintain a distinction between US-born and foreign-born respondents by disentangling them by birthplace and offering a lens for similarly parsing data in future studies. Subsequent research could examine in particular how the "disconnect" is happening such that preventable and treatable prostate and colorectal cancer no longer disparately and gratuitously affect populations.

Compliance with Ethical Standards

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

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