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Research Article

Relationship between Chronic Disease Conditions and Colorectal Cancer Screening: Results from the 2012 National Health Interview Survey Data

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Abstract

Background: Uptake of screening remains crucial in the prevention of both the incidence of colorectal cancer (CRC) and its mortality.

Objectives: To estimate the prevalence of CRC screening and identify chronic conditions that predict CRC screening uptake among US adults using the 2012 National Health Interview Survey (NHIS) data.

Materials and Methods: A cross-sectional analysis of the 2012 NHIS data. Chronic conditions examined were hypertension, cancer history, arthritis, ulcer, and high cholesterol level. A total of 21,511 participants were included in the analysis. Weighted univariate and multiple logistic regression analyses in SAS ver. 9.2 were used to estimate the odds ratios (ORs) with 95% confidence intervals (CIs).

Results: The overall prevalence of CRC screening was 19%. The prevalence of CRC screening in adults with cancer history, hypertension, ulcer, high cholesterol, and arthritis was significantly higher than those without the chronic conditions (26% vs.18%, 23% vs.16%, 25% vs.18%, 23% vs. 16%, and 23% vs. 17%, respectively). After adjusting for potential factors, hypertension (OR=1.18, 95%CI=1.08-1.30), ulcer (OR=1.28, 95%CI=1.10-1.48), high cholesterol (OR=1.25, 95%CI=1.14-1.39), and arthritis (OR=1.24, 95%CI=1.12-1.37) were all positively associated with CRC screening ($p<0.05$). Females were less likely to screen for CRC than to males (OR=0.72; 95% CI=0.65-0.80). Compared to young adults (18-44 years), screening was significantly higher in middle-aged (45-64 years) and elder adults (65+) (OR=2.60, 95%CI=2.11-3.21 and OR=2.67, 95%CI=2.13-3.33, respectively). African Americans were more likely to screen for CRC compared to their white counterparts (OR=1.61, 95% CI=1.44-1.81).

Conclusions: We have found significant associations between chronic conditions and CRC screening uptake. We also found higher uptake of CRC screen in African Americans than Whites, in contrast to earlier findings.

Keywords: Colorectal cancer; Screening; Cancer history; Hypertension; Cholesterol; Arthritis

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Introduction

Colorectal cancer (CRC) is the fourth leading cause of cancer mortalities globally [1]. It accounted for 608, 000 deaths worldwide in 2008 [1]. CRC affects both sexes significantly. In the United States (US), CRC is the third most common cancer and the second leading cause of cancer deaths; it was estimated that 136, 830 people would be diagnosed with CRC and about 50, 310 people would die of the disease in the US in 2014 [2]. The lifetime risk of CRC is about 5% for both men and women in the US [3, 4]. Five year survival rate of CRC is low at late diagnosis of the disease; however, CRC death can be prevented by early detection and treatment. Five-year survival rate has been shown to be at least 90% when the condition is detected early and treated before tumor has extended; survival reduces to 70% when tumor has extended and is under 13% when metastasis has already taken place [3, 5].

Deaths from CRC have been decreasing for both men and women in the US [6]. There has also been declining rate of CRC incidence which is attributed to a reduction in exposure to risk factors, early detection, and prevention by polypectomy [7]. Early detection, prevention, and early treatment are possible due to availability of screening programs for at risk groups in the US. Uptake of screening therefore remains crucial in the prevention of both the incidence of CRC and its mortality. Screening for CRC is effective, safe, and relatively inexpensive [8]. A significant reduction in deaths from CRC attributed to screening has been shown in both randomized trials and observational studies [9-12]. Different screening tools exist for CRC. Sensitivity and specificity for various tests have been shown to be appropriate for screening [8]. For instance, a clinical trial has shown that a single sigmoidoscopy screening of adults between 55 and 64 years resulted in 33% and 43% reductions in incidence and mortality of CRC, respectively [13]. In the US, a consensus guideline for CRC screening has been published and screening is covered by most health plans [14].

However, uptake of CRC screening is still about 50% of those eligible or for whom the test is highly recommended [2, 15]. Predictors of CRC screening are similar to those of other tests and they include age, educational level, income level, being married, and health insurance status [15, 16]. But unlike other cancer screening tests such as mammography, CRC screening rates remains low despite availability of effective and safe test tools. In contrast to the well-known gender differences in health behavior [17], men show higher acceptance rate for CRC screening than females [18,19]. Public health researchers have sought to find an answer to this deviation. Some have asserted that the observation may be explained by the fact that the incidence of colonic adenomas is higher in men than women [20], hence, the assumption that it is a male condition [21]. Others also observed that over-emphasis on similar health conditions with screening guidelines specific to women such as breast and cervical cancer seem to have focused women's attention on those conditions to the detriment of CRC screening [22,23]. However, since physician visits have been found to correlate with CRC screening [21,24], it is expected that women screening for breast cancer and other diseases will receive information on CRC risk and the need for screening. Such awareness will dispel any misconception about CRC. On the other hand, if attention to other well publicized health programs hinders CRC screening, it raises a question regarding the effect one health concern has on other important health issues. Will attention to other chronic disease affect health behavior towards another important health issues? Studies have so far not well evaluated the association between chronic diseases and CRC screening. A study to find this association will not only answer an important question but will also inform policy about the need to tailor CRC screening to other chronic disease management.

Methods

Data source

The National Health Interview Survey (NHIS) is a multi-purpose health survey conducted by the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention (CDC), and is the principal source of information on the health of the civilian non-institutionalized household population of the US. The NHIS has been conducted continuously since 1957. Public use data files are released on an annual basis. From each family in the NHIS, one sample adult aged 18 years or older is randomly selected, and information is collected with sample adult core questionnaires. The 2012 NHIS sample size is the largest sample size since the current sample design was implemented in 2006. Detailed methods of this survey have been published elsewhere [25].

Variables

Subjects were considered to have had CRC screening if they responded "yes" to the question "During the past 12 months, have you had any test done for colon cancer?" (Table 1). Colon cancer tests include blood stool tests, colonoscopy and sigmoidoscopy. A blood stool test is a test that may use a special kit at home to determine whether the stool contains blood. A sigmoidoscopy and colonoscopy involve insertion of a tube into the rectum to view the colon for signs of cancer or other health problems. Social factors used in this study were age group classified as young (18-44 years), middle aged (45-64 years), and elderly (65 years or older), gender, race/ethnicity (White, African American (AA), Asian and other). Other demographic characteristics included education (≤high school, > high school) and health insurance (yes, no). Marital status had three categories: married/living with partner, widowed/divorced/separated, and never married. All health condition variables were dichotomized to yes or no. Cancer history was defined by the question "Ever been told by a doctor you had cancer?" Arthritis was defined by the question "Ever been told by a doctor you had arthritis?" Hypertension was asked by the question "Ever been told by a doctoryou had hypertension?" High cholesterol was determined by the question "Ever been told by a doctor you had high cholesterol?" Ulcer was defined by the question "Ever been told by a doctor you had an ulcer?"

Statistical Analysis

The SAS PROC SURVEYFREQ procedure was used to weight and estimate population proportions in chronic conditions and social factors. SAS PROC SURVEYMEANS was used to estimate the overall prevalence of CRC screening, whereas SAS PROC SURVEYFREQ determined the prevalence in potential determinants. The Chi-square test was used to compare prevalence across chronic conditions. Then, SAS PROC SURVEYLOGISTIC was used to estimate the odds ratios (ORs) and 95% confidence intervals (CIs) for the relationship between potential factors and CRC screening. We estimated both crude and adjusted odds ratios for our independent variables. Since colorectal cancer incidence increases with age, we set the young adults as our reference for the analysis. All the analyses were conducted with SAS statistical software, version 9.2 (SAS Institute, Cary, NC, USA).

Table 1 Subjects characteristics of the 2012 National Health Interview Survey

Variable	CRC screening (weighted %) N=4,040	Non-screening (Weighted %) N=17,471
Gender		
Male	2026(54%)	7516(46%)
Female	2014(46%)	9955(54%)
Age group		
18-44 years	182(5%)	2609(16%)
45-64 years	2194(59%)	9340(57%)
65 +	1664(36%)	5522(27%)
Race		
White	2819(79%)	13015(80%)
AA	800(13%)	2469(10%)
Asian	129(3%)	547(3%)
Other	292(5%)	1440(7%)
Marital status		
Married	2205(70%)	8916(66%)
Widowed/Divorced/Separate	1447(24%)	6401(25%)
Never	385(6%)	2105(9%)
Education		
≤HS	1776(42%)	8668(49%)
>HS	2210(58%)	8438(51%)
Insurance		
No	106(2%)	1597(7%)
Yes	3933(98%)	15857(93%)
Cancer history		
No	3285(82%)	15406(88%)
Yes	753(18%)	2054(12%)
Hypertension		
No	1833(48%)	9899(60%)
Yes	2203(52%)	7549(40%)
Ulcer		
No	3574(89%)	16013(92%)
Yes	462(11%)	1444(8%)
High cholesterol		
No	2078(52%)	10976(63%)
Yes	1953(48%)	6432(37%)
Arthritis		
No	2364(60%)	11822(69%)
Yes	1673(40%)	5629(31%)

Abbreviations: AA=African American; HS=High school

*Data Source: CDC/NCHS, National Health Interview Survey, 2012

Table 2 CRC screening prevalence in chronic disease conditions (%)

Variable	Total (N)	CRC screening (N)	Prevalence (%)	95%CI	P
Cancer history					
No	18691	3285	17.6	16.9-18.3	<0.0001
Yes	2807	753	26.4	24.4-28.4	
Hypertension					
No	11732	1833	15.8	14.9-16.6	<0.0001
Yes	9752	2203	22.7	21.8-23.7	
Ulcer					
No	19587	3574	18.2	17.5-18.8	<0.0001
Yes	1906	462	25.0	22.6-27.3	
High cholesterol					
No	10976	2078	15.9	15.1-16.7	<0.0001
Yes	8385	1953	23.3	22.2-24.4	
Arthritis					
No	14186	2364	16.5	15.8-17.3	<0.0001
Yes	7302	1673	23.4	22.1-24.6	
Overall	21511	4040	18.8	18.1-19.4	

P-value is based on χ^2 test

*Data Source: CDC/NCHS, National Health Interview Survey, 2012

Results

Subjects characteristics and prevalence

A total of 21,511 respondents, comprising 9,542 (44%) males and 11,966 (56%) females were included in the analysis. Table 1 shows the characteristics of the study participants. In males, the percentage of CRC screening was higher than the non-screening group (54% vs. 46%). Prevalence of CRC screening was higher in older adults than young adults (36% vs. 27%). AA adults and married adults reported higher cases of CRC screening than Whites and never married respectively (13% vs. 10%, 70% vs. 66%, respectively). More adults with higher education and health insurance received CRC screening than low education and uninsured (58% vs. 51%, 98% vs. 93%, respectively).

Table 2 shows the prevalence of CRC screening in chronic disease conditions. The overall prevalence of CRC screening was 19%. The prevalence of CRC screening in adults with cancer history, hypertension, ulcer, high cholesterol, and arthritis were significantly higher than those without the chronic conditions (26% vs.18%, 23% vs.16%, 25% vs.18%, 23% vs. 16%, and 23% vs. 17%, respectively).

Table 3 Univariate and multiple logistic regression analyses for the relationship between potential factors and CRC screening

Variable	Crude OR	95% CI	P-value	Adjusted OR	95% CI	P-value
Gender						
Male	1			1		
Female	0.75	0.68-0.82	<0.0001	0.72	0.65-0.80	<0.0001
Age group						
18-44 years	1			1		
45-64 years	2.98	2.42-3.68	<0.0001	2.60	2.11-3.21	<0.0001
65 +	3.76	3.03-4.66	<0.0001	2.67	2.13-3.33	<0.0001
Race						
White	1			1		
AA	1.39	1.24-1.54	<0.0001	1.61	1.44-1.81	<0.0001
Asian	0.99	0.78-1.26	0.760	1.10	0.86-1.40	0.450
Other	0.81	0.68-0.96	0.0032	1.04	0.87-1.24	0.663
Marital status						
Married	1			1		
Widowed/Divorced/Separate	0.90	0.82-0.99	0.0304	0.87	0.79-0.96	0.0072
Never	0.66	0.57-0.76	<0.0001	0.73	0.63-0.85	<0.0001
Education						
≤HS	1			1		
>HS	1.35	1.22-1.49	<0.0001	1.30	1.18-1.44	<0.0001
Insurance						
No	1			1		
Yes	4.59	3.42-6.16	<0.0001	3.60	2.73-4.76	<0.0001
Cancer						
No	1			1		
Yes	1.70	1.51-1.91	<0.0001	1.42	1.26-1.60	<0.0001
Hypertension						
No	1			1		
Yes	1.58	1.45-1.72	<0.0001	1.18	1.08-1.30	0.0003
Ulcer						
No	1			1		
Yes	1.50	1.31-1.73	<0.0001	1.28	1.10-1.48	0.0013
High cholesterol						
No	1			1		
Yes	1.60	1.46-1.76	<0.0001	1.25	1.14-1.39	<0.0001
Arthritis						
No	1			1		
Yes	1.55	1.41-1.70	<0.0001	1.24	1.12-1.37	<0.0001

Abbreviations: AA=African American; HS=High school; OR=Odds ratio; CI=Confidence interval

*Data Source: CDC/NCHS, National Health Interview Survey, 2012

The relationship between all potential risk factors and CRC screening

Table 3 shows the results of both univariate and multiple regression analyses of the potential factors with CRC screening. All factors were associated with CRC in the univariate analysis ($p<0.05$). After adjusting for potential confounding factors, cancer history (OR=1.42, 95%CI=1.26-1.60), hypertension (OR=1.18, 95%CI=1.08-1.30), ulcer (OR=1.28, 95%CI=1.10-1.48), high cholesterol (OR=1.25, 95%CI=1.14-1.39), and arthritis (OR=1.24, 95%CI=1.12-1.37) were all positively associated with CRC screening ($p<0.05$). Females were less likely to screen for CRC than males (OR=0.72; 95% CI=0.65-0.80). Compared to young adults (18-44 years), screening was significantly higher in middle-aged and elder adults (OR=2.60, 95%CI=2.11-3.21 and OR=2.67, 95%CI=2.13-3.33, respectively). AAs were more likely to screen for CRC than white counterparts (OR=1.61, 95% CI=1.44-1.81). Compared to the married, screening uptake was less likely in the divorced/widowed/separated (OR=0.87, 95% CI=0.79-0.96) and in the never married (OR=0.73, 95%CI=0.63-0.85). Education was significantly associated with CRC screening. Education level higher than senior high school is associated with 30% increase in the odds of CRC screening. The odds of CRC screening within the last 12 months in those who had insurance were 3.6 times that of those who did not have insurance (95% CI=2.73-4.76).

Discussion

In this study, we found that the prevalence of CRC screening in adults with cancer history, hypertension, ulcer, high cholesterol, and arthritis was significantly higher than those without those chronic conditions. After adjusting for potential confounding factors, cancer history, hypertension, ulcer, high cholesterol, and arthritis were all positively associated with CRC screening ($p<0.05$).

As has been reported earlier, CRC screening rate is lower in women than men. Adjusting for all potential variables, CRC screening was still significantly higher in men than women. Some researchers have attributed the low uptake of CRC screening in women to the perception that CRC is men's disease [17]. Others have proposed there is a greater attention to other cancers such as breast cancer and such attention has overshadowed the importance of CRC [22,23]. However, since presence of other chronic diseases has been found to increase uptake of CRC screening, the diverted attention hypothesis does not fully explain the gender difference in CRC screening. Again, since physician visit has been found to increase CRC screening [17,18], awareness of the conditions seems to be very important in the decision to screen.

We also found screening uptake to increase with age. More than 90% of all those who reported having been screened for CRC were over 44 years old. Screening uptake was highest in those above 64 years. The age difference is explained by the fact that CRC risk increases with age and screening is recommended for those who 50 years [26] and above in the US.

In terms of race, CRC screening uptake was significantly higher in AA compared to Whites while all other races were not significantly different from Whites. This finding contrasts earlier observations [15,16]. The higher uptake rate in AAs may be due to the fact that both incidence of and mortality from CRC are highest in AAs [27-31] than all other ethnic groups in the US.

Our results indicate that being married or living with a partner increases the chance of being screened for CRC. Those who are divorced, separated or widowed were also better off in uptake of CRC screening than

the never-married group. It has been known that being married is associated with CRC screening uptake [16]. An earlier study attributed the health difference to financial protection enjoyed by unemployed married women [32]. However, Schoenborn (2004) observed that married adults were healthier than other adults regardless of population demographics or health indicator [33]. The difference in screening uptake, aside from other factors, may be due to support couples enjoy from their partners. However, a longitudinal study may be able to better explain this difference.

Level of education was also found to determine the likelihood of CRC screening uptake in our sample. Those who have received education higher than senior high school are more likely to receive screening for CRC. Education is well known to be a significant determinant of health. In terms of screening, education level of an individual may influence the level of understanding of CRC and the benefits of screening. Such insight is more likely to drive a person to accept and undergo screening [34].

Insurance significantly increases the chances of being screened for CRC in our sample. Odds of been screened for CRC in the past 12 months in those insured were 3.6 times that of those who did not have any insurance. It has been shown that most insurance policies currently cover CRC screening [26]. Such coverage offers a relief of further financial burden from a CRC screening, and therefore lead to increased uptake of CRC screening by those insured. On the other hand, the uninsured may be constrained financially to screen for CRC. Again, differences in insurance status may reflect differences in economic level in our sample. Effect of insurance status on CRC screening may also be explained by health consciousness. With the same socio-economic levels, people who are more health conscious are more likely to buy health plans than those who are less health conscious. The difference in attitude toward health is more likely to result in significant differences in screening uptake. Another possible explanation for the effect of insurance status is risk perception. People who perceive themselves as being at increased risk for health problems are more likely to buy health plans and offer themselves for screening than those who perceive themselves as not being at risk for health problems.

All of the chronic conditions included in the analysis were significantly associated with CRC screening uptake in both the univariate and multiple logistic regression analyses. Among the chronic conditions, cancer history showed the strongest association with CRC screening uptake. People diagnosed with cancer may consider themselves at risk of other cancers and therefore will take advantage of existing screening programs. Being treated for a cancer will likely expose an individual to the awareness of CRC screening and the benefit associated with it. It has been shown that family CRC history is a predictor for CRC screening [35]. History of having an ulcer was second to cancer in terms of strength of association with CRC screening. Investigation, treatment and education to ulcer patients are more likely to lead acceptance and uptake of CRC screening.

Of greater interest is the effect of elevated cholesterol level on CRC screening uptake. It showed the third strongest strength of association with screening uptake. Since elevated cholesterol level is asymptomatic and more unlikely to lead people to seek medical attention, its association with CRC screening is more likely mediated by health consciousness. Furthermore, it has been reported that individuals who have high cholesterol do seem to have an increased risk of CRC [36].

High blood pressure and arthritis also showed an association with CRC screening uptake. Like the other chronic conditions, hypertension and arthritis are more likely to bring patients into contacts with physicians and other health professionals more often. Such contacts may lead to awareness of available health services including CRC screening and increase in the uptake of screening. People coming into contact more often with

physicians are more likely to receive information on CRC screening, resulting in an increase in uptake [21,24]. Few studies have focused on the relationship between arthritis and hypertension and CRC screening. One recent study reported that individuals with rheumatoid arthritis (RA) did not appear to be at risk for receiving fewer cancer screening tests than non-RA patients; while there was no significant difference in having at least one Pap smear, mammogram or colonoscopy between patients with RA and hypertension [37].

Strengths and limitations

Our study used a nationally representative sample and therefore the results can be generalized. The large sample size also gives us a statistical power in our estimates. However, since the study is a cross-sectional, causal association cannot be established. Further, our analysis is based on self-report and therefore prone to recall bias. However, colon cancer test is relatively invasive and it is unlikely that an individual will not recall this diagnosis.

Conclusion

We have found significant association between chronic conditions and CRC screening uptake**.** In contrast to earlier findings, we have found higher uptake of CRC screen in AA than Whites. Further studies should examine whether this association is mediated by physician visits. It is important to develop effective strategies to manage these chronic conditions; the role of physicians in the CRC screening should be stressed.

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