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Diet, Alcohol Use, and Colorectal Cancer Screening among Black Church-goers

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Abstract

Objectives—Interventions for colorectal cancer (CRC) prevention among black adults are needed. Connections between CRC screening non-adherence and other health risk behaviors may inform intervention development.

Methods—Associations between red meat (RM) and fruit and vegetable (FV) consumption, at-risk alcohol use, and CRC ever-screening were examined using adjusted logistic regressions among 520 church-going black adults in Houston, Texas, aged >50.

Results—In the final adjusted model, being younger, uninsured, eating more RM and engaging in at-risk alcohol use were associated with lower likelihood of CRC ever-screening.

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Human Subjects Approval Statement: The Institutional Review Board at The University of Texas MD Anderson Cancer Center approved this study, and the Institutional Review Board at the University of Houston reviewed and approved this study as an exempt protocol. Written informed consent for all study procedures was obtained before data collection.

Conflict of Interest Declaration: The authors have no competing interests pertaining to this research.

Conclusions—Church-based interventions to increase CRC screening among black adults might capitalize on associations with RM consumption and alcohol use behaviors as part of a broader wellness promotion initiative.

Keywords

diet; alcohol; African-American; colorectal cancer screening

According to the Centers for Disease Control and Prevention, colorectal cancer (CRC) is the third most common cancer in men and women and the third leading cause of cancer-related deaths in the United States (U.S.).¹ Medical risk factors for CRC include a family history of CRC and certain medical conditions including diabetes and inflammatory bowel disease.² Behavioral risk factors for CRC include low physical activity, smoking, and obesity.² In addition, some studies suggest that dietary factors are associated with a higher risk of developing CRC, including higher red meat (RM) consumption³⁻⁶ and lower fruit and vegetable (FV) intake (for colon cancer only),⁷⁻¹⁰ as well as moderate to heavy alcohol use.¹¹⁻¹⁴ Fortunately, the early detection of precancerous growths via screening procedures such as sigmoidoscopy or colonoscopy (endoscopy) can prevent CRC and save lives.^{2,15,16} Likewise, screening tests such as stool-based tests (fecal occult blood test) can detect CRC in its early stages, leading to higher survival rates.² Because the majority of new CRC (90%) are diagnosed in adults aged 50 or older, CRC screening guidelines reflect that, for most adults without medical pre-dispositions, screenings should begin at this age.² Unfortunately, despite associations with decreased colorectal cancer incidence and mortality, only 59% of the U.S. population aged 50 and older is current with recommended guidelines for CRC screening.¹⁷

Non-adherence to CRC screening guidelines appears to be influenced by various system factors, such as the cost of screening, a lack of health insurance, and a failure to receive physician advice to screen,¹⁸⁻²¹ as well as personal barriers (embarrassment).²² CRC screening compliance has been linked with health risk behaviors as well. Specifically, greater RM consumption,^{16,23-27} less FV intake,^{9,10, 23, 26} and greater alcohol consumption¹¹⁻¹⁴ have been associated with lower likelihood of CRC screening compliance. Thus, dietary and alcohol use behaviors may not only be associated with CRC risk, but also linked to the failure to utilize screening procedures to prevent a CRC diagnosis.

Understanding factors associated with CRC screening non-compliance is important to inform health promotion interventions designed to prevent CRC. Such studies are particularly critical for certain racial groups, such as black adults, who suffer disproportionately from CRC incidence and mortality relative to white adults.¹⁵ Recent national statistics indicate that the CRC incidence rate among non-Hispanic black men is 63.8 (per 100,000) versus 50.9 among non-Hispanic white men.² These differences in incidence are echoed among women as well (non-Hispanic black vs white women: 29.4 vs 19.2 per 100,000).² Likewise, CRC mortality also varies by race. The CRC mortality rate nationally among non-Hispanic black men and women is 29.4 and 19.4 (per 100,000) versus 19.2 and 13.6 among non-Hispanic white men and women.² Despite these CRC disparities, status as current with CRC screening recommendations, defined as having a stool-based test

in the past year or sigmoidoscopy/colonoscopy in the past 10 years among adults aged 50 or older, is lower among non-Hispanic black (55.5%) as compared to non-Hispanic white adults (61.5%).² In Texas, current compliance with CRC screening is 60.1% overall for adults aged 50 or older, ranking Texas as the 41st of 51 states in the nation in this regard.² Interestingly, compliance by race as reported in the state does not evince the disparities seen in national data, with a reported 65.9% current compliance with guidelines among non-Hispanic whites and 68.7% among non-Hispanic black adults.² However, the confidence interval for the latter is approximately three times that of the former, potentially reflecting some estimation error. Regardless, racial disparities in CRC incidence and mortality among Texans are evident.²

Echoing the literature more generally, barriers to CRC screening among black adults include the cost of screening, a lack of access to health care, lower educational level, and a lack of physician's advice to obtain screening.²⁸⁻³² One study focused on CRC screening non-compliance, conducted via a state-wide survey of black adults living in Maryland, found that more than half of participants were non-compliant with CRC screening recommendations.²⁸ In this case, compliance was defined as a stool-based test within 1 year, a sigmoidoscopy within the last 5 years, or colonoscopy within the last 10 years among individuals aged >50 years. Among this sample of black adults without a family history of CRC, social system factors including education, employment, insurance, and provider recommendations yielded the strongest influence on timely CRC screening relative to biological or psychological/behavioral factors.²⁸ Although it is clear that social system factors are critical to address in increasing CRC screening compliance among black adults in order to reduce CRC-related health disparities, the association of behavioral risk factors and CRC screening non-compliance may also be of interest for health promotion intervention development. Specifically, if engagement in health risk behaviors is associated with CRC screening non-compliance, CRC screening promotion interventions might be broadened to target overall wellness, including attention to improving associated health risk behaviors to prevent health disparities more broadly.

Although there have been studies devoted to better understanding correlates of CRC screening non-compliance among black adults,²⁸⁻³² none to our knowledge have examined these relations among a church-based sample. This is of interest because data suggest that the majority of black adults belong to a church or synagogue,³³ and more than half of black adults attend church weekly.^{34,35} Moreover, data suggest that many sermons in black churches in recent years may reflect social issues, including “practical advice for daily living,”³³ which might include information on maintaining good health. In addition, many churches have health-focused ministries whose mission is to improve the health of their constituents through the dissemination of health promotion information. Consequently, cancer prevention interventions targeting black adults may be not only be well-placed but also well-received in church settings.³⁶ Moreover, if CRC health promotion dissemination is already occurring in a church setting, the factors associated with screening non-compliance may be unique relative to those who do not attend church. Better understanding the associations between health risk behaviors and CRC screening non-compliance may help to inform church-based health promotion interventions directed toward reducing CRC risk.

The current study adds to the literature by characterizing CRC screening compliance (ever-screened versus never-screened) and examining the association between behavioral risk factors and CRC screening compliance among a sample of black adults aged 50 years from a church-based cohort study. Due to associations with CRC screening non-compliance in previous literature,^{11,13, 16, 23, 26} the current study focused on the behavioral risk factors of RM consumption, FV consumption, and at-risk alcohol use. In particular, this study benefitted from being able to examine the relation between dual dietary behaviors (RM and FV consumption), at-risk alcohol use, and CRC screening status in a single church-based sample while controlling for several covariates including sociodemographics, smoking, physical activity, obesity, self-rated health, and family history of colon cancer.

Methods

Design

Data were from the first year of a longitudinal cohort study designed to delineate factors associated with cancer risk among black adults. Participants (N=1501) comprised a convenience sample recruited into a cohort study focused on cancer prevention among black adults from a large church in Houston, Texas. Recruitment was accomplished via church-televized media and in-person solicitation. Participants were required to be 18 years old, residents of the Houston area with a functional telephone number, and church attendees (membership was not a requirement). Data were collected between December 2008 and July 2009. Surveys were completed in person at the church, and participants were compensated with a \$30 gift card. Study procedures were approved by the Institutional Review Boards at the primary institution and approved as an exempt protocol at the main auxiliary institution. Written informed consent was obtained from all participants.

Measures

Participant characteristics—Participant characteristics included age, sex, education (< Bachelor's degree, Bachelor's Degree, or Master's Degree), annual income (<\$40,000, \$40,000-79,999, or \$80,000), partner status (married/living with partner or single/widowed/divorced), employment status (employed or not employed/retired), insurance status (private, Medicare/other, or no insurance), obesity status (obese or not obese, based on investigator-measured height and weight), smoking status (current smoker or former/never smoker), physical activity level (low, moderate, or high rates of activity, based on the International Physical Activity Questionnaire-Short Form), self-rated health (excellent/very good, good, or fair/poor), and family history of colon cancer (yes or no).⁹⁻¹¹

Red meat consumption—RM items were as follows: 1) “How often have you eaten salami, bologna, sausage, kielbasa, bacon, chorizo, deli meat, hot dogs, or similar processed meats (2 ounces, 2 small links, or 2 strips)?”; 2) “How often have you eaten hamburgers?”; 3) “How often have you eaten beef, ham, pork, or lamb in a sandwich or in a mixed dish, for example, in a stew, casserole, or lasagna?”; and 4) “How often have you eaten 4-6 ounces of beef, ham, pork, or lamb as a main dish, for example, as a roast, steak or chops?” Answer options for each item were: 1=never, 2=1-3 times in four weeks, 3=once a week, 4=2-4 times a week, 5=5-6 times a week, and 6=once or more a day. The frequency of RM

consumption per week was assessed by converting the responses to number of times per week (mid-point or the closest value was used if response option was not a single value), then adding these 4 RM items for weekly RM intake.

Fruit and vegetable consumption—FV intake was assessed with the NCI Five-A-Day fruit and vegetable questionnaire (excluding fried potatoes).¹² FV items assessed the frequency of consumption of: 1) 100% orange juice or grapefruit juice; 2) other 100% fruit juices, not counting fruit drinks; 3) green salad, with or without other vegetables; 4) baked, boiled, or mashed potatoes; 5) vegetables, not counting salad or potatoes; and 6) fruit, not counting juices. Answer options for each item were: 0=never, 1=1-3 times last month, 2=1-2 times a week, 3=3-4 times a week, 4=5-6 times a week, 5=1 time a day, 6=2 times a day, 7=3 times a day, 8=4 times a day, and 9=5 or more times a day. Similar to RM consumption, the frequency of daily FV consumption was assessed by summing responses of the 6 items after converting the responses to number of times per day.

At-risk alcohol use—At-risk alcohol use was assessed with the Alcohol Quantity and Frequency Questionnaire, which assesses participant's average daily alcohol intake via self-report.¹³ Participants were classified as at-risk drinkers if they consumed an average of >14 drinks per week and were men or if they consumed an average of >7 drinks per week and were women.

CRC screening status—CRC screening status was determined by self-report of having been screened for CRC with a stool-based test, sigmoidoscopy, or colonoscopy (ever screened or never screened). For the stool-based test, participants were asked: “A stool blood test, also known as a Fecal Occult Blood Test, is a test done to check for colon cancer. It is done at home using a set of 3 cards to determine whether the stool contains blood. Have you ever done this test using a home kit?” For sigmoidoscopy and colonoscopy, the following two questions were asked: 1) “A sigmoidoscopy and a colonoscopy are both tests that examine the bowel by inserting a tube in the rectum. Have you ever had a sigmoidoscopy?” and 2) “Have you ever had a colonoscopy?” Participants aged 50 or older who endorsed having been screened for CRC using any method were considered CRC screening compliant for the purposes of this study based on guidelines that adults of any CRC risk category should have been screened at least once by age 50.²

Data Analysis

Analyses were performed using SAS version 9.3 (SAS Institute, Cary, NC). Data relevant to CRC screening were only asked among a subset of the cohort (persons aged ≥50; N = 582), 62 of whom had missing data for sample characteristics, RM consumption, FV consumption, and/or CRC screening status. Consequently, the analyzable sample comprised 520 African-American adults aged ≥50. Excluded participants differed significantly from included participants only on income. Specifically, people with higher income (\$40,000-\$79,999) were more likely to be included in the study compared with people earning less than \$40,000 a year in income (OR[95%CI]=2.56[1.21-5.42], p = 0.014).

Participant characteristics were examined using descriptive statistics. Significant differences between the CRC ever-screened and the CRC never-screened were evaluated using chi-square tests or t-tests. The association between RM consumption and CRC screening status, FV consumption and CRC screening status, and at-risk alcohol use and CRC screening status were each evaluated in respective logistic regression models adjusted for age, sex, education, income, partner status, employment status, insurance status, obesity status, smoking status, physical activity level, self-rated health, and family history of colon cancer. A final model included all variables entered simultaneously to examine unique variance. Models were examined for multicollinearity using Variance Inflation Factors. Model fits were measured using Hosmer-Lemeshow tests. Significance was set at $p = .05$.

Results

Participants ($N = 520$) ranged from age 50-86, and were $57.4 (\pm 6.4)$ years old on average. About half of the participants reported attending church once per week ($N = 194$) and 37.4% attended more than once per week. A minority of the sample reported attending church less than once per week (7.9%). See Table 1 for all characteristics and differences based on CRC screening status.

Results from the first logistic regression analysis indicated that higher RM consumption was associated with lower odds of CRC screening in fully adjusted analyses ($p = .046$). Results from the second analysis indicated that at-risk alcohol use was also associated with lower odds of CRC ever-screening in fully adjusted analyses ($p = .0014$). However, results from the third analysis indicated that FV consumption was not significantly associated with CRC screening status ($p = .21$).

A final fully-adjusted model indicated that RM consumption and at-risk alcohol use remained significantly associated with CRC screening status, as did age and insurance status. See Table 2 for information on this fully adjusted model.

Discussion

In this sample of 520 church-going black adults, approximately 77% reported having ever been screened for CRC. This is a higher rate than has been reported in at least one other study among black adults ($<50\%$),²⁸ as well as has been reported among non-Hispanic black adults aged >50 years in Texas overall (68.7%).² The higher rate of CRC screening compliance in this study likely reflects the nature of the CRC screening variable itself, which assessed ever-screening in the present study as opposed to timely receipt of CRC screening informed by guidelines based on screening method as in the referenced works. The extent to which the present sample was currently compliant with CRC screening guidelines was not assessed and is unknown, but evidence suggests that having ever-screened for CRC is associated with reduced CRC mortality,² making it an important criterion variable in its own right. Nevertheless, in terms of generalizability, it is also important to consider that screening rates in this sample might reflect that the participants comprised a convenience sample of individuals interested in participating in a cohort study focused on cancer prevention among this racial group, and were perhaps more aware of

cancer screening than those who did not participate. These differences may also reflect that the church from which participants were sampled has health-focused ministries and that sermons given during regular services sometimes reflect factors important to maintaining a healthy lifestyle, practices which may not be uncommon among black churches.³³ Moreover, the sample was fairly well-educated (>50% had at least a Bachelor's degree), with substantive resources (>36% of households earned over \$80,000 annually), and largely health insured (>90% of the sample had insurance), which might have increased the likelihood of awareness about and access to CRC screening.

One of the purposes of the current study was to characterize factors associated with CRC ever-screening among this sample of church-going black adults aged 50 or older. As shown in Table 1, participants in the ever-screened for CRC group were more likely to be older, unemployed/retired, married/living with partner, and with health insurance coverage. In addition, the ever-screened had marginally greater FV consumption and were significantly less likely to engage in at-risk drinking relative to the never-screened participants. On the other hand, there were no differences on the sociodemographic variables of sex, educational level, and income by CRC screening status among this sample. Furthermore, behavioral risk factors including RM consumption, physical activity level, obesity, and smoking status and medical status risk factors such as self-rated health and family history of colon cancer were also not significantly different by CRC screening status. While some of these patterns reflect extant literature (FV intake, alcohol use, health insurance),^{9-14,16,17, 23,26} others (RM consumption, age)^{16,23-27,37} do not. For example, an analysis of black adults who participated in the Behavior and Risk Factor Surveillance Survey indicated that the percentage of black adults getting screened declined as age increased.³⁷ Some of these differences with previous literature likely reflect differences in the CRC screening variable (older individuals in this sample may have been more likely to have ever-screened because advanced age would allow increased opportunity for ever-screening, though they may not necessarily be compliant with timely CRC screening) or in screening recommendations for elderly adults. Future research should be conducted among other black church-going samples to better understand the potential for the generalizability of these results to other congregations.

The other purpose of the current study was to identify correlates of CRC screening in multivariate analyses, with a specific focus on dietary behaviors and at-risk alcohol use, to inform health promotion interventions. Results indicated that, after controlling for several variables including sociodemographics, smoking, physical activity, obesity, self-rated health, and family history of colon cancer, participants who consumed more RM and engaged in at-risk alcohol use were less likely to have ever been screened for CRC. Aside from these variables, the only additional covariates contributing unique variance to the prediction of CRC screening were age and insurance status. Findings reflect those of previous literature citing that lower rates of CRC screening co-occurred with higher rates of unhealthy behaviors, including increased RM consumption and moderate to heavy alcohol use,^{23,38-42} and extend them to church-going black adults. These findings are important because they reflect that the similar behavioral risk factors that may increase risk of CRC are also associated with lowers odds of CRC screening compliance. Consequently, health promotion interventions for CRC screening compliance provided within church settings or by church

ministries should capitalize on associations with RM consumption and at-risk alcohol use as part of a broader wellness promotion initiative. Stated another way, educational or interventional church-based campaigns highlighting the benefits of CRC prevention or early detection for black adults may need to target individuals who may also engage in CRC risk behaviors (moderate to heavy alcohol, greater RM consumption), which presents an opportunity to also promote changes in eating and drinking habits that will function to lessen CRC risk as well as promote overall wellness. This may include strategies including education provision (the link between these behaviors and CRC risk) as well as more formal intervention provision. For example, CRC risk prevention interventions such as those used in Project Prevent⁴³ (cognitive behavioral skills training, motivational interviewing-based therapy sessions, tailored interventions which matched the participant's motivation level, take home self-help binders with educational materials) might be extended to CRC screening compliance/wellness interventions provided in a church setting. The present results aid in identifying the risk behavior targets for such health promotion interventions.

This study was also focused on the contribution of FV consumption to CRC screening status. Despite significant differences in the mean consumption of FV by CRC screening status, the association between FV intake and CRC screening status was nonsignificant in multiple logistic regression analyses. This particular result adds clarification to questions surrounding the issue of FV intake and CRC, which has been implicated with somewhat inconsistent support as an influencing factor in CRC risk and screening.^{28,40} The current results suggest that health behaviors other than FV consumption may be better suited as areas for attention and potential sites for intervention among black church-going adults who are not compliant with CRC screening.

Study limitations should be noted. First, the current study was focused on status as ever-versus never-screened, as opposed to the timeliness of CRC screenings over time. Although having ever-screened for CRC reduces the CRC mortality rate,² adhering to recommended screening guidelines would further reduce the CRC mortality rate among black adults. Future studies should examine associations of behavioral risk factors and timely adherence to recommended CRC screening guidelines. Another study variable limitation is the absence of inquiry about all CRC screening tests (eg, double-contrast barium enema, fecal immunochemical test). However, the tests identified in this study are among the most common screening measures used and reported in surveillance studies.² In addition, study variable limitations included the potential omission of other variables associated with CRC screening non-compliance, including a lack of information on the receipt of physician advice to screen. Also, we relied on self-report of CRC screening behaviors, which may be subject to inaccuracy. Second, the study used a convenience sample comprising largely health insured church-going black adults, over 50% of whom had at least a Bachelor's degree, living in a large metropolitan area in the South. Although the focus on church attendees was among the contributions of this study to the literature, results may not be generalizable to all church-going black adults, to black adults who do not attend church, to samples with lower health insurance rates or less education, or to church-going black adults from other regions of the U.S. Third, this study was cross-sectional and causal associations between the behavioral risk factors examined and CRC screening were not assessed. Therefore, while changing behavioral risk factors such as diet may impact CRC risk, the impact of behavior

change on CRC screening compliance is unknown. Also, although at-risk alcohol use was associated with lower odds of CRC screening compliance in this church-attending sample, it should be noted that absolute rates of at-risk alcohol use were quite low (4.4%). However, lower use of alcohol may be characteristic of regular church attendees.⁴⁴ Finally, because no adjustments were made to account for the multiple statistical analyses conducted herein, results should be viewed with caution and are in need of replication. However, it is worthy of note that the only other study we are aware of that explored similar factors among a non-church going, similarly sized sample of black adults took a like approach to data analysis and interpretation,²⁸ which may reflect the initial and exploratory nature of research with this at-risk group.

Implications for Health Behavior or Policy

The current study adds to the existing literature by providing information about the associations between dietary intake, at-risk alcohol use and CRC screening status in a large sample of church-going black adults aged 50 or older. Results of the current study indicate that black adults who consumed greater weekly servings of RM and engaged in at-risk alcohol use were less likely to have ever-screened for CRC than their counterparts. Since non-compliance with CRC screening is associated with higher CRC risk, and because black adults have lower CRC screening compliance rates and higher CRC incidence and mortality rates relative to white adults,¹⁵ it is important to develop interventions to increase CRC prevention among black adults. The present study could inform such interventions by highlighting the opportunity to target the reduction of RM consumption and at-risk alcohol use as part of an overall wellness mission, given that those most at risk of CRC screening non-compliance may exhibit these health risk behaviors. Although not examined in this study, interventions to address CRC risk factors and CRC prevention might be well-received in a church setting, particularly if designed with and by the church community and its leadership.³⁶ Many churches have various ministries, including health ministries,³³ that could enact both active (health education, referral to screening facilities) and passive (availability of brochures about CRC screenings and prevention) dissemination strategies focused on CRC prevention in the church setting. The delivery of such messages within a trusted setting like a church, which capitalizes on the community that members and church attendees share as well as the social networks that connect them, may have a greater public health impact on CRC prevention among black adults than health promotion efforts directed more broadly at the general population.

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Table 1

Participant Characteristics and Differences by Colorectal Cancer Screening (CRC) Status.

Characteristics	Whole Sample (N=520)	CRC Never screened (N=120)	CRC Ever screened (N=400)	p value
	Mean[SD] / n(%)	Mean[SD] / n(%)	Mean[SD] / n(%)	
Age	57.4 [6.4]	54.4 [4.6]	58.3 [6.5]	<.001
Sex				.098
Male	120 (23.1)	21 (17.5)	99 (24.8)	
Female	400 (76.9)	99 (82.5)	301 (75.3)	
Educational Level				.135
< Bachelor's degree	251 (48.3)	58 (48.3)	193 (48.3)	
Bachelor's degree	157 (30.2)	43 (35.8)	114 (28.5)	
Master's degree	112 (21.5)	19 (15.8)	93 (23.3)	
Annual Household Income				.468
< \$40,000	115 (22.1)	31 (25.8)	84 (21.0)	
\$40,000-\$79,999	213 (41.0)	49 (40.8)	164 (41.0)	
\$80,000	192 (36.9)	40 (33.3)	152 (38.0)	
Partner Status				.049
Single/Widowed/Divorced	271 (52.1)	72 (60.0)	199 (49.8)	
Married/Living with Partner	249 (47.9)	48 (40.0)	201 (50.3)	
Employment Status				<.001
Unemployed/retired	172 (33.1)	23 (19.2)	149 (37.3)	
Employed	348 (66.9)	97 (80.8)	251 (62.8)	
Health Insurance Status				<.001
Private	327 (62.9)	74 (61.7)	253 (63.3)	
Medicare/Other	142 (27.3)	21 (17.5)	121 (30.3)	
None	51 (9.8)	25 (20.8)	26 (6.5)	
Obesity Status				.288
Not obese	208 (40.0)	43 (35.8)	165 (41.3)	
Obese	312 (60.0)	77 (64.2)	235 (58.8)	
Smoking status				.333
Former/Never smoker	475 (91.3)	107 (89.2)	368 (92.0)	
Current smoker	45 (8.7)	13 (10.8)	32 (8.0)	
Physical Activity level				.500
Low	135 (26.0)	30 (25.0)	105 (26.3)	
Moderate	143 (27.5)	38 (31.7)	105 (26.3)	
High	242 (46.5)	52 (43.3)	190 (47.5)	
Self-rated Health				.442
Excellent/Very good	175 (33.7)	46 (38.3)	129 (32.3)	
Good	256 (49.2)	56 (46.7)	200 (50.0)	
Fair/Poor	89 (17.1)	18 (15.0)	71 (17.8)	
Family history of colon cancer				.071
No	431 (82.9)	106 (88.3)	325 (81.3)	

Characteristics	Whole Sample (N=520)	CRC Never screened (N=120)	CRC Ever screened (N=400)	p value
	Mean[SD] / n(%)	Mean[SD] / n(%)	Mean[SD] / n(%)	
Yes	89 (17.1)	14 (11.7)	75 (18.8)	
Red Meat Consumption	4.5 [3.7]	5.0 [4.0]	4.3 [3.6]	.090
Fruit and Vegetable Intake	3.4 [2.6]	3.0 [1.9]	3.5 [2.8]	.050
At-risk Alcohol Use Status				<.001
Not at-risk drinker	497 (95.6)	106 (88.3)	391 (97.8)	
At-risk drinker	23 (4.4)	14 (11.7)	9 (2.3)	

Note: Significant differences between the CRC never screened and the CRC ever screened were evaluated using chi-square tests or t-tests.

Table 2

Adjusted Associations of Red Meat Intake, At-Risk Alcohol Use, and Colorectal Cancer Screening Status (reference group = never screened).

Characteristics	β (SE)	χ^2 value	p value	OR (95% CI)
Age	0.1038 (0.0282)	13.60	.0002	1.11 (1.05-1.17)
Sex				
Male	0.3738 (0.3069)	1.48	.2232	-
Educational Level				
Bachelor's degree	-0.3294 (0.2809)	1.38	.2409	-
Master's degree	-0.0688 (0.3461)	0.04	.8425	-
Annual Household Income				
\$40,000-\$79,999	0.3082 (0.3399)	0.82	.3647	-
\$80,000	0.5243 (0.4078)	1.65	.1985	-
Partner Status				
Married/Living with Partner	0.0473 (0.2678)	0.03	.8598	-
Employment Status				
Unemployed/retired	0.5879 (0.3258)	3.26	.0712	-
Health Insurance Status				
Private	1.1513 (0.3808)	9.14	.0025	3.16 (1.50-6.67)
Medicare/Other	1.3198 (0.4321)	9.33	.0023	3.74 (1.61-8.73)
Obesity Status				
Not obese	0.1416 (0.2523)	0.32	.5746	-
Smoking status				
Former/Never smoker	0.0812 (0.3952)	0.04	.8373	-
Physical Activity level				
Low	0.1924 (0.2917)	0.44	.5095	-
Moderate	-0.1102 (0.2818)	0.15	.6957	-
Self-rated Health				
Excellent/Very good	-0.1843 (0.3777)	0.24	.6255	-
Good	0.0474 (0.3418)	0.02	.8897	-
Family history of colon cancer				
No	-0.5050 (0.3443)	2.15	.1424	-
Red Meat Consumption	-0.0651 (0.0310)	4.41	.0357	0.94 (0.88-0.996)
At-risk Alcohol Use Status				
Not at-risk drinker	1.6298 (0.4973)	10.74	.0010	5.103 (1.93 – 13.52)

Note: Associations were examined within a single logistic regression analysis. Reference groups for binary and categorical variables were not shown in this table but are indicated in text and Table 1. Odds ratios were only displayed for significant variables.