

# Alcohol Consumption, Depression, Insomnia and Colorectal Cancer Screening: Racial Differences

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**Background:** Mortality from colorectal cancer (CRC) can be reduced drastically by early detection and early treatment. However, uptake of CRC screening is relatively low, about 50% for those whom the test is highly recommended.

**Objectives:** We examined the influence of and racial differences in depression, insomnia, alcohol use, and tobacco use on CRC screening uptake in the US.

**Patients and Methods:** Analysis of the 2012 National Health Information Survey data was conducted. Both weighted univariate and multiple logistic regression analyses were performed in SAS to estimate the odds ratios (ORs) and their 95% confidence intervals (CIs). A total of 21511 participants were included in the analysis.

**Results:** Prevalence of CRC screening in the participants was 19%. Adjusting for all factors, insomnia (OR = 1.18, 95%CI = 1.06 - 1.32), moderate alcohol drinking (OR = 1.16, 95%CI = 1.01 - 1.30), past smoking (OR = 1.17, 95%CI = 1.04 - 1.32), depression (OR = 1.37, 95%CI = 1.18 - 1.58), African American (AA) race, and cancer history were positively associated with CRC screening. Females and Single were inversely associated with CRC screening prevalence. In stratified analysis by races (White and AA), depression was associated with CRC screening in both races. Marital status, smoking, cancer history and insomnia were associated with CRC screening in Whites only; while alcohol use was associated with CRC screening in AAs only.

**Conclusions:** We have found significant associations between lifestyle factors (alcohol consumption and smoking) and mental health problems (depression and insomnia) and CRC screening uptake. To improve overall CRC screening uptake in the US, it is important to consider racial differences in predictors and tailor appropriate interventions to each racial/ethnic group.

**Keywords:** Colon Cancer; Screening; Alcohol Consumption; Depression; Insomnia

## 1. Background

Colorectal cancer (CRC) remains the second leading cause of cancer deaths in the United States (US) (1), despite the high survival rate from early treatment (2). It is estimated that 136830 new cases of colorectal cancer will be recorded in 2014 in the US and 50310 of these cases will die from the disease (3). Cancer of the colon and rectum affects both males and females equally, and the risk increases with age (3, 4). Mortality from CRC can be reduced drastically by early detection and early treatment. The survival rate for colorectal cancer is very low at late diagnosis of the disease. Five-year survival rates as high as about 90% have been reported for tumors detected and removed before extension (2). Evidence also indicates a reduction in the survival rate to about 70% for tumors which have already extended, and as low as 13% when metastasis has already occurred (2). Decline in CRC mortality rates in the US has been attributed to early detection and surgical removal of the tumor before metastasis (5). Early detection and early treatment are possible due to the availability of effective and relatively inexpensive CRC screening tests (6). A clinical trial showed 33 and 43% reductions in incidence

and mortality of CRC respectively as result of a single sigmoidoscopy screening of adults between 55 and 64 years (7). In the US, CRC screening is covered by most health plans and there is a published guideline for CRC screening (8). However, uptake of CRC screening is relatively low, and it is about 50% of those for whom the test is highly recommended (9-11). This calls for public health efforts to increase awareness, acceptance and uptake of CRC screening, especially for those with increased risk. Researching factors that promote CRC screening is therefore crucial for public health interventions. Reported predictors of CRC screening include age, educational level, income level, and health insurance status (9, 12). These predictors are similar to predictors for other screening programs, such as mammography. It therefore raises questions about the low uptake of CRC compared to screening programs for other cancers. This calls for more investigation into predictors of CRC screening uptake to inform policy and intervention planning. Several studies exist on the relationship between mental health and attitudes towards health programs. The link between depression, alcohol and tobacco

use; and screening uptake have also been investigated. However, studies have differed on their findings. A study investigated the influence of depression on other cancer screening among breast cancer survivors in Latino. An inverse association was observed between depression and CRC screening uptake (13). A recent survey in Washington State in the US identified depression as a significant barrier to cervical cancer screening uptake (14). This finding partly corroborated a previous observation made in Canada (15). However, Kaida and co-workers (15) observed that age played an important role in the relationship between depression and cervical cancer screening. In contrast, Kodl and co-workers observed a significant increase in CRC uptake among those with mental health diagnosis in a bivariate analysis (16). However, inverse association was observed when they controlled for timing of diagnosis and outpatient visits. This observation suggests that depression affects screening indirectly. In the United Kingdom, it was observed that lower depression indirectly increases uptake of CRC screening through a better self-rated health (17). These findings call for more investigation into the relationship between mental health and CRC screening to inform policy and intervention. Insomnia has been found to be common among cancer patients (18). However, to the best of our knowledge, the relationship between insomnia and CRC screening uptake has not yet been evaluated. Again, racial differences in the influence of depression on CRC screening have not yet been evaluated.

## 2. Objectives

We examined the influence of and racial differences in depression, insomnia, alcohol use, and tobacco use on CRC screening uptake in the USA.

## 3. Patients and Methods

### 3.1. Data Source

The National Health Interview Survey (NHIS) is a multi-purpose health survey which is conducted by the National Center for Health Statistics (NCHS), Center for Disease Control and Prevention (CDC). It is a principal source of health information of the civilian noninstitutionalized household population of the US. The NHIS has been conducted continually since it began in 1957. Public-use data files are released annually and can be accessed from the internet. From each family in the NHIS, one adult aged 18 years or older is randomly selected to respond to sample adult core questionnaires. Details of the methods of this survey have been published elsewhere (19). The 2012 NHIS sample is the largest sample size since the current sampling strategy came into force in 2006. Analysis of 2012 data from the National Health Information survey (NHIS) was done to determine associations between depression, insomnia, alcohol use and tobacco use, and colorectal cancer screening in participants.

**Table 1.** Subjects Characteristics of the 2012 National Health Interview Survey <sup>a,b,c</sup>

Variable	CRC Screening (n = 4040)	Non-Screening (n = 17471)
<b>Gender</b>		
Male	2026 (54)	7516 (46)
Female	2014 (46)	9955 (54)
<b>Age group, y</b>		
18 - 44	182 (6)	2609 (16)
45 - 64	2194 (59)	9340 (57)
≥ 65	1664 (36)	5522 (27)
<b>Race</b>		
White	2819 (79)	13015 (80)
AA	800 (13)	2469 (10)
Asian	129 (3)	547 (3)
Other	292 (5)	1440 (7)
<b>Marital status</b>		
Married	2205 (70)	8916 (66)
Divorced	1447 (24)	6401 (25)
Single	385 (6)	2105 (9)
<b>Income, USD</b>		
0 - 34999	1431 (26)	7012 (32)
35000 - 74999	1198 (33)	4944 (32)
≥ 75000	1141 (41)	4379 (36)
<b>Cancer history</b>		
No	3285 (82)	15406 (88)
Yes	753 (18)	2054 (12)
<b>Alcohol use</b>		
Never	776 (18)	3897 (21)
Past	888 (21)	3455 (20)
Moderate	2151 (61)	9055 (50)
<b>Smoking status</b>		
Never	2063 (51)	9609 (56)
Current	623 (14)	3135 (17)
Past	1348 (35)	4695 (27)
<b>Depress</b>		
No	3244 (87)	14609 (89)
Yes	570 (13)	2082 (11)
<b>Insomnia</b>		
No	3021 (76)	13556 (79)
Yes	1018 (24)	3912 (21)

<sup>a</sup> Abbreviations: AA, African American.

<sup>b</sup> Data Source: CDC/NCHS, National Health Interview Survey, 2012.

<sup>c</sup> Data are presented as No. (%).

### 3.2. Measurements

Information on depression, insomnia, alcohol use and tobacco use was self-reported. Participants were considered to have had a CRC screening (case) if they responded “yes” to the question “Test for colon cancer, past 12 months” (Table 1). Subjects who answered “no” to the question served as controls. Demographic variables collected and used in this analysis included age, 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). Marital status was classified into married/living with partner; widowed/divorced/separated; and Single. Insomnia was determined by the question “Insomnia, past 12 months” (yes. no). Depression case was recorded from “yes” answer to the question “Ever had depression, past 12 months” (yes/no). Smoking status was classified as never smoked, current smoking, or past smoking. Alcohol consumption was classified as never, current light or moderate drinking, and past drinking. Income level was categorized into low income (0 - 34999 USD), middle income (35000 - 74999 USD) and high income ( $\geq 75000$  USD).

### 3.3. Statistical Analysis

Population proportions in cases and controls of independent variables and demographic factors were estimated by PROC SURVEYFREQ procedure in SAS. PROC SURVEYMEANS procedure was also used to estimate the overall prevalence of CRC screening; while SAS PROC SURVEYFREQ was used to estimate the prevalence in potential factors. Chi-square test was used to compare prevalence of CRC screening across groups. Odds ratios (ORs) and their 95% confidence intervals (CIs) were estimated for each of the suspected predictors of CRC screening by PROC SURVEYLOGISTIC procedure. A multiple logistic regression was performed for all races combined and then stratified by race (white and AA). All the analyses were conducted with SAS statistical software, version 9.2 (SAS Institute, Cary, NC, USA).

## 4. Results

### 4.1. Subjects Characteristics and Prevalence

There were 21511 participants included in the analysis, comprising 9542 (44%) males and 11966 (56%) females. Table 1 shows detailed characteristics of the study participants. A higher percentage of males reported having CRC screening in the last 12 months (54% vs. 46%). Proportion of older adults was higher in cases than in controls (36% vs. 27%). African-American (AA) adults and married also formed higher proportions in cases than in controls (13% vs. 10%, 70% vs. 66%, respectively). A higher proportion of cases had higher income than controls (41% vs. 36%). Table 2 illustrates the prevalence of CRC screening by demographic factors and other

independent variables. The overall prevalence of CRC screening in the sample was 19%. The prevalence of CRC screening in adults with cancer, depression and insomnia was significantly higher than those without the conditions (26% vs.18%; 21% vs.18%; and 21% vs.18%, respectively). Prevalence of CRC screening was highest in past smokers compared to current smokers and never smokers (23% vs. 16% vs. 18%). Participants with past alcohol use recorded the highest prevalence of CRC screening compared to current and never alcohol users (20% vs.19% vs. 16%).

### 4.2. The Relationship Between all Potential Risk Factors and CRC Screening in all Races

Results of both univariate and multiple logistic regression analyses of the association between CRC screening and all factors included in the model are shown in Table 3. There were significant associations between CRC screening and all factors examined in the unadjusted analysis ( $P < 0.05$ ). Adjusting for all other factors, cancer history (OR = 1.51, 95%CI = 1.32 - 1.73); moderate alcohol drinking (OR=1.16, 95%CI=1.01-1.30); past smoking (OR=1.17, 95%CI = 1.04 - 1.32); depression (OR = 1.37, 95%CI = 1.18 - 1.58); AA race (OR=1.74, 95% CI=1.53 -1.98) and insomnia (OR = 1.18, 95%CI = 1.06 - 1.32) were all positively associated with CRC screening. Females (OR = 0.73; 95% CI = 0.66 - 0.82) and Single (OR = 0.78, 95% CI = 0.66 - 0.91) were inversely associated with CRC screening prevalence. Compared to young adults (18 - 44 years), screening was significantly higher in middle-aged and the older adults ( $\geq 65$ ) (OR = 2.91, 95%CI = 2.35 - 3.62 and OR = 3.76, 95%CI = 2.99 - 4.74, respectively). Compared to low income earners (0 - 34999 USD), CRC screening was significantly higher in middle income (35000 - 74999 USD) and high income ( $\geq 75000$ ) earners (OR = 1.32, 95% CI = 1.17 - 1.48; and OR = 1.50, 95% CI = 1.31 - 1.73, respectively).

### 4.3. Relationship Between CRC Screening and all Factors Stratified by Race (White and African American)

Table 4 provides detailed results of multiple logistic regression analysis, stratified by race. Adjusting for all other factors, age, income and depression showed significant positive association with CRC screening in both Whites and AAs. In both races, females were less likely to screen for CRC. While the single were significantly less likely to receive CRC screening among Whites (OR = 0.75, 95%CI = 0.61 - 0.92), marital status was not significantly associated with CRC screening among AA ( $P > 0.4$ ). Cancer history was positively associated with CRC screening in Whites (OR = 1.55, 95%CI = 1.33 - 1.79) but not significant in AAs ( $P > 0.1$ ). There was a 47% significant increase in CRC screening in past alcohol users among AAs (95% CI = 1.06 - 2.09) but alcohol use was not associated with CRC screening in Whites ( $P > 0.1$ ). In both races, CRC screening was slightly

but not significantly reduced in current smokers, however, past smoking was positively associated with CRC screening in Whites (OR = 1.29, 95% CI = 1.09 - 1.53) but not

in AAs. History of insomnia also increased CRC screening in Whites (OR = 1.17, 95% CI = 1.03 - 1.34) but it was not significantly associated with CRC screening in AAs.

**Table 2.** CRC Prevalence of Demographic Characteristics (%) <sup>a,b,c</sup>

Variable	Total, N	Cases, N	Prevalence, %	95%CI	P Value
<b>Gender</b>					< 0.0001
Male	9542	2026	21.2	20.2 - 22.3	
Female	11969	2014	16.5	15.62 - 17.4	
<b>Age group, y</b>					< 0.0001
18 - 44	2791	182	7.4	6.1 - 8.8	
45 - 64	11534	2194	19.4	18.5 - 20.4	
≥ 65	7186	1664	23.0	21.9 - 24.2	
<b>Race</b>					< 0.0001
White	15834	2819	18.4	17.7 - 19.2	
AA	5269	800	23.6	21.8 - 25.3	
Asian	676	129	17.9	14.5 - 21.3	
Other	1732	292	14.9	12.9 - 17.0	
<b>Marital status</b>					< 0.0001
Married	9542	2205	19.7	18.2 - 22.3	
Divorced	11969	1447	18.2	15.6 - 17.4	
Single	11969	385	13.4	11.9 - 14.9	
<b>Income, USD</b>					< 0.0001
0 - 34999	8443	1431	15.9	15.0 - 16.9	
35000 - 74999	6142	1198	19.5	18.3 - 20.6	
≥ 75000	5520	1141	20.7	19.4 - 22.1	
<b>Cancer history</b>					< 0.0001
No	18691	3285	17.6	16.9 - 18.3	
Yes	2807	753	26.4	24.4 - 28.4	
<b>Alcohol use</b>					
Never	4673	776	16.3	14.8 - 17.7	0.0009
Past	4343	888	20.3	18.6 - 21.8	
Moderate	11206	5151	19.3	18.3 - 20.3	
<b>Smoking status</b>					< 0.0001
Never	11672	2063	17.6	16.6 - 18.5	
Current	3758	623	15.7	14.3 - 17.2	
Past	6043	1348	22.8	21.4 - 24.1	
<b>Depression</b>					0.0019
No	17853	3244	18.3	17.6 - 18.9	
Yes	2652	570	21.4	19.4 - 23.4	
<b>Insomnia</b>					0.0001
No	16577	3021	18.1	17.4 - 18.9	
Yes	4930	1018	20.9	19.6 - 22.3	
<b>Overall</b>	21511	4040	18.8	18.1 - 19.4	

<sup>a</sup> Abbreviations: AA, African American.

<sup>b</sup> P value is based on  $\chi^2$  test.

<sup>c</sup> Data Source: CDC/NCHS, National Health Interview Survey, 2012.

**Table 3.** Univariate and Multiple Logistic Regression Analyses for the Relationship Between Potential Factors and CRC Screening <sup>a,b</sup>

Variable	Crude OR	95%CI	P Value	Adjusted OR	95%CI	P Value
<b>Gender</b>						
Male	1			1		
Female	0.73	0.66 - 0.81	< 0.0001	0.73	0.66 - 0.82	< 0.0001
<b>Age group, y</b>						
18 - 44	1			1		
45 - 64	2.99	2.42 - 3.70	< 0.0001	2.91	2.35 - 3.62	< 0.0001
≥ 65	3.71	2.98 - 4.63	< 0.0001	3.76	2.99 - 4.74	< 0.0001
<b>Race</b>						
White	1			1		
AA	1.35	1.21 - 1.52	< 0.0001	1.74	1.53 - 1.98	< 0.0001
Asian	0.90	0.69 - 1.16	0.406	1.05	0.80 - 1.37	0.732
Other	0.80	0.67 - 0.95	0.01	1.07	0.89 - 1.28	0.489
<b>Marital status</b>						
Married	1			1		
Divorced	0.91	0.83 - 0.99	0.0456	0.91	0.82 - 1.02	0.114
Single	0.67	0.58 - 0.78	< 0.0001	0.78	0.66 - 0.91	0.002
<b>Income, USD</b>						
0 - 34999	1			1		
35000 - 74999	1.28	1.15 - 1.42	< 0.0001	1.32	1.17 - 1.48	< 0.0001
≥ 75000	1.34	1.19 - 1.50	< 0.0001	1.50	1.31 - 1.73	< 0.0001
<b>Cancer history</b>						
No	1			1		
Yes	1.71	1.52 - 1.94	< 0.0001	1.51	1.32 - 1.73	< 0.0001
<b>Alcohol use</b>						
Never	1			1		
Past	1.34	1.14 - 1.58	0.0004	1.14	0.96 - 1.36	0.142
Moderate	1.25	1.11 - 1.42	0.0004	1.16	1.01 - 1.34	0.0361
<b>Smoking status</b>						
Never	1			1		
Current	0.90	0.78 - 1.03	0.112	0.90	0.78 - 1.05	0.176
Past	1.40	1.26 - 1.56	< 0.0001	1.17	1.04 - 1.32	0.0119
<b>Depress</b>						
No	1			1		
Yes	1.23	1.08 - 1.40	0.0025	1.37	1.18 - 1.58	< 0.0001
<b>Insomnia</b>						
No	1			1		
Yes	1.18	1.07 - 1.31	0.0014	1.18	1.06 - 1.32	0.0041

<sup>a</sup> Abbreviations: AA, African American; OR, Odds ratio; CI, Confidence interval.

<sup>b</sup> Data Source: CDC/NCHS, National Health Interview Survey, 2012.

## 5. Discussion

In the combined analysis, increasing age, high income, being male, depression, insomnia, past smoking, moderate alcohol drinking, and AA race were all associated with increased CRC screening. CRC screening prevalence was significantly reduced in the Single

compared to the married or living with partner. In a stratified analysis by race groups, significant differences in CRC screening predictors were observed between Whites and AAs. There was a significant increase in CRC screening with increasing age, increasing income level,

and depression in both races. Similar to the combined analysis, females were less likely to screen for CRC in both Whites and AAs. Cancer history, marital status, and insomnia were associated with CRC screening in Whites but not in AAs. Past alcohol drinking increased screening in AAs but alcohol was not associated with screening in Whites. The relationship between age, gender, income level and CRC screening have been widely reported in the literature, and our findings are in line with those already reported (9, 12). However, in con-

trast with findings in the literature (9, 12), our analysis found a significant increase in CRC screening among AAs compared to Whites. This increase may stem from perception of risk. Though our analysis cannot fully explain why CRC screening is higher in AAs than Whites, it is important to note that incidence of and mortality from CRC have been reported to be higher in AAs than all other racial/ethnic groups in the USA (20-24). Awareness of this statistics can trigger uptake of screening as has been shown previously (25).

**Table 4.** Multiple Logistic Regression Analysis for the Relationship between Potential Factors and CRC Screening by Race Status <sup>a,b</sup>

Variable	Adjusted OR (White)	95%CI	P Value	Adjusted OR (AA)	95%CI	P Value
<b>Gender</b>						
Male	1			1		
Female	0.71	0.62 - 0.80	< 0.0001	0.77	0.61 - 0.97	0.0251
<b>Age group, y</b>						
18 - 44	1			1		
45 - 64	2.66	2.08 - 3.98	< 0.0001	3.62	2.15 - 6.09	< 0.0001
≥ 65	3.20	2.47 - 4.14	< 0.0001	4.96	2.84 - 8.64	< 0.0001
<b>Marital status</b>						
Married	1			1		
Divorced	0.89	0.78 - 1.02	0.0953	1.10	0.87 - 1.41	0.429
Single	0.75	0.61 - 0.92	0.0067	0.93	0.68 - 1.26	0.630
<b>Income, USD</b>						
0 - 34999	1			1		
35000 - 74999	1.32	1.14 - 1.51	0.0001	1.46	1.15 - 1.86	0.0021
≥ 75000	1.47	1.25 - 1.73	< 0.0001	1.53	1.10 - 2.13	0.0112
<b>Cancer history</b>						
No	1			1		
Yes	1.55	1.33 - 1.79	< 0.0001	1.29	0.91 - 1.84	0.157
<b>Alcohol use</b>						
Never	1			1		
Past	1.03	0.83 - 1.28	0.772	1.49	1.06 - 2.09	0.0218
Moderate	1.13	0.95 - 1.34	0.157	1.19	0.86 - 1.65	0.301
<b>Smoking status</b>						
Never	1			1		
Current	0.94	0.79 - 1.11	0.470	0.79	0.58 - 1.08	0.146
Past	1.17	1.02 - 1.34	0.0302	1.23	0.91 - 1.65	0.178
<b>Depress</b>						
No	1			1		
Yes	1.29	1.09 - 1.53	0.0027	1.81	1.27 - 2.57	0.001
<b>Insomnia</b>						
No	1			1		
Yes	1.17	1.03 - 1.34	0.0185	0.93	0.69 - 1.24	0.620

<sup>a</sup> Abbreviations: AA, African American; OR, Odds ratio; CI, Confidence interval.

<sup>b</sup> Data Source: CDC/NCHS, National Health Interview Survey, 2012.

The observation that moderate alcohol drinking was associated with increase CRC screening is similar to previously reported influence of alcohol consumption on mammography (26). However, our results indicate that the relationship between moderate alcohol drinking and cancer screening may be race-dependent. When stratified by race, the observed 16% increase in CRC screening in moderate alcohol consumption completely attenuated. It resulted in 47% significant increase in CRC screening among past alcohol users but only in AAs. More studies are needed to explain the racial difference. We have found no significant difference in CRC screening between current and never smokers in contrast to earlier finding that smoking reduces cancer screening (27, 28). In line with a previous report (10), we found past smoking to increase CRC screening in the combine analysis. Our stratified analysis indicated that past smoking increased screening in Whites only. Motivation to cease smoking may increase positive health behavior among past smokers. It suggests that campaigns to increase smoking cessation may also lead to improvement in healthy behaviors. Our findings on depression contrast most of the evidence reported earlier (13-15, 29). However, our analysis did not account for hospital visits. Number of outpatient visits has been found to mediate mental illness and health behavior (16). We are unable to attribute the observed influence of depression to physician visit based on our data, however, it is more plausible for depressed individuals to have increased contact with care providers (16) and the result may reflect the importance of health care provider contacts and screening uptake. This may also apply to those who reported symptoms of insomnia in the last 12 months. Increased contact with health care providers may increase uptake of health screening. Insomnia may affect up to 50% of patients with cancer and increases cancer symptom burden and impairs quality of life (18, 30-33). However, to the best of our knowledge, this study is the first to examine the relationship between insomnia and CRC screening uptake. We found that insomnia was positively associated with CRC screening and the associations showed race difference. Of significant important is the observed variation between Whites and AAs on the predictors examined. Though our data is limited to explain these differences, it suggests that race specific interventions may be important in improving uptake of CRC screening. However, further studies on these variations may be important to explain the difference. Our study is statistically powerful due to the large sample size. The use of probability sampling technique makes our sample representative of the population. Since information from participants was self-reported, our study may suffer from a recall bias as well as social desirability bias. However, recall bias is likely to be minimal since information collected was within one year. In conclusion, cancer history, smoking status, insomnia and alcohol intake status may influence CRC screening uptake differently between Whites and

AAs. To improve overall CRC screening uptake in the US, it is important to consider racial differences in predictors and tailor appropriate interventions to each racial/ethnic group.

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## Authors' Contributions

Daniel Owusu drafted the manuscript. Megan Quinn provided a substantive review of the manuscript. Ke Sheng Wang managed analyses and designed the study. All authors read and approved the manuscript.

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