

# No association between colorectal cancer worry and screening uptake in Appalachian Ohio

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## ABSTRACT

**Background** Limited data are available on the association between colorectal cancer (CRC) worry and CRC screening uptake, particularly in rural and underserved populations where there is an excess burden of CRC.

**Methods** Between September 2009 and March 2010, we conducted a cross-sectional study among a randomly selected sample of Appalachian Ohio residents aged 51–75 years ( $n = 1084$ ). We also reviewed their medical records. Multivariable-adjusted models examined the association between CRC worry and screening by medical record review, assessed effect modification by CRC worry and determined the correlates of higher CRC worry.

**Results** Approximately 50% of participants were adherent to CRC screening guidelines. There was no significant association between higher CRC worry and screening adherence [odds ratio (OR) = 1.32, 95% confidence interval (CI): 0.86–2.02]. CRC worry did not modify the association between any covariate and screening adherence. Participants who were unemployed/disabled (OR = 2.15, 95% CI: 1.34–3.45) and had higher CRC risk perception (OR = 3.49, 95% CI: 2.19–5.56) had higher odds of moderate-to-extreme worry.

**Conclusions** These findings highlight the need for meaningful exploration of why higher CRC worry is not associated with adherence to CRC screening, particularly in rural, medically underserved populations. Development and implementation of interventions to increase CRC screening in such areas is a significant public health priority.

**Keywords** cancer, communities, screening

## Introduction

In the USA, colorectal cancer (CRC) is the third most commonly diagnosed cancer and the third leading cause of cancer-specific mortality in both men and women.<sup>1</sup> It is estimated that, in 2014, 136 830 people will be diagnosed with CRC and 50 310 will die from CRC.<sup>1</sup> The US Preventive Services Task Force recommends CRC screening by fecal occult blood test (FOBT) annually, sigmoidoscopy every 5 years, with high-sensitivity FOBT or colonoscopy every 10 years among average-risk adults aged 50–75 years,<sup>2</sup> although these screening services are not typically free of charge in the state of

Ohio. The goal of screening is to reduce CRC mortality through early detection and prevention.<sup>3</sup> In the USA, the

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prevalence of CRC screening uptake has increased in the past decade, although generally CRC screening has been low overall (~60%).<sup>4</sup>

While many studies have identified CRC risk perception as a predictor of adherence to CRC screening guidelines, little is known about the association between CRC worry and CRC screening uptake. Studies that have examined this association have suggested that higher levels of CRC worry are associated with increased odds of completing CRC screening;<sup>5-7</sup> however, little data are currently available on the correlates of CRC worry. Understanding the role worry plays in CRC screening behaviors is a necessary undertaking as it could prove an important target of patient-focused interventions to increase CRC screening, which could be particularly useful among populations with an increased CRC burden, such as observed in the rural and medically underserved Appalachian region. Given the lack of association between perceived risk and CRC screening we previously reported in the Appalachian region,<sup>8</sup> we sought to investigate whether CRC worry was associated with screening and determine whether CRC worry modified the associations between other covariates and being within CRC screening guidelines. An additional aim of this study was to determine the correlates of higher levels of CRC worry.

## Methods

The details of the study sample and design have been described elsewhere.<sup>8</sup> Briefly, between September 2009 and March 2010, we conducted a cross-sectional telephone survey with a randomly selected sample [from lists provided by a commercial vendor (InfoUSA, Papillion, NE, USA)] of residents of 12 Ohio Appalachian counties (Athens, Gallia, Guernsey, Harrison, Jackson, Jefferson, Lawrence, Meigs, Morgan, Muskingum, Perry and Scioto). Based on 2010 Census data, these 12 counties represent a total population of ~558 000 (with an average county population of 95 per square mile), and have higher than average CRC incidence, compared with other parts of Ohio and the US overall (as reported to the Ohio Cancer Information Surveillance System between 2000 and 2004). The purpose of this survey was to establish baseline CRC screening rates in this area. We also obtained signed releases for collection of participants' medical records that were reviewed for confirmation of self-reported screening uptake. Participants were in the age of 51–75 years, had no known preexisting CRC risk factors (i.e. had no prior history of CRC, familial/hereditary cancer syndrome, polyps or inflammatory bowel disease) and were, therefore, considered at average risk for CRC. This study was approved by the university's Institutional Review Board and written informed consent was obtained from all participants.

The baseline telephone survey collected data on CRC screening behaviors, demographic characteristics, smoking status, general health and CRC screening knowledge, social influence and attitudes, as previously described.<sup>8</sup> CRC screening status was obtained by reviewing medical records. Adherence to CRC screening<sup>2</sup> was defined as having one of the following: (i) FOBT in the past year; (ii) flexible sigmoidoscopy in the past 5 years or (iii) colonoscopy in the past 10 years. Participants were asked 'how much do you worry about getting colon cancer?' (five-point scale: not at all, a little, moderately, quite a bit and extremely). Given the distribution of this variable (extremely, 0.5%; quite a bit, 1.5%; moderately, 11.3%; a little, 35.9% and not at all, 50.8%), CRC worry was dichotomized [very little worry (not at all and a little, referent group) versus moderate-to-extreme worry (moderately, quite a bit, extremely)] in all statistical models. Multiple imputation<sup>9</sup> was used to impute missing data on adherence to CRC screening and income. A fully conditional specification imputation method was implemented.<sup>10</sup> Missing income was imputed using a discriminant function including all covariates of interest (Table 1) along with self-reported CRC screening status. Missing screening data were imputed using a logistic regression model containing income (imputed or observed value) and all covariates of interest. Monotone missingness was induced by omitting participants with incomplete data for any covariate of interest (1.9% of participants).

Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to describe the associations between covariates and being adherent to CRC screening guidelines by medical record, with stratification by CRC worry and to determine the correlates of moderate-to-extreme CRC worry. For the multivariable model of moderate-to-extreme CRC worry, we used a backward selection process whereby a potential predictor was omitted based on the *P*-value ( $P < 0.2$  criterion) obtained by combining the estimates from 40 imputed data sets. All analyses were conducted in SAS 9.2 or 9.3 (SAS Institute, Cary, NC, USA); PROC MI (SAS 9.3) was used to impute the data and PROC MIANALYZE (SAS 9.2) was used to combine the estimated ORs from the 40 imputed data sets.

## Results

### CRC worry and adherence to CRC screening guidelines

Data are reported on 1084 participants with complete data on all variables of interest (except income and CRC screening status by medical record review, which were imputed if missing). As shown in Table 1 (and as previously described<sup>8</sup>),

**Table 1** Associations between participant characteristics and being within guidelines for CRC screening by medical record review, stratified on extent of CRC worry,  $n = 1084$ 

	Very little worry, $n = 942$		Moderate-to-extreme worry, $n = 142$		$P_{interaction}$
	$n$ (%)	OR (95% CI) <sup>a</sup>	$n$ (%)	OR (95% CI) <sup>a</sup>	
Demographic characteristics					
Age (years), mean $\pm$ SD	61.5 $\pm$ 6.9	1.04 (1.02, 1.06)	61.0 $\pm$ 6.6	1.04 (0.99, 1.11)	0.83
Gender					
Male	399 (42.4)	1.00 (referent)	49 (34.5)	1.00 (referent)	0.59
Female	543 (57.6)	0.96 (0.72, 1.27)	93 (65.5)	1.21 (0.55, 2.66)	
Race					
Non-white	24 (2.6)	1.00 (referent)	11 (7.8)	1.00 (referent)	0.53
White	918 (97.4)	0.89 (0.36, 2.20)	131 (92.2)	1.54 (0.36, 6.65)	
Marital status					
Single/never married	41 (4.3)	1.00 (referent)	6 (4.2)	1.00 (referent)	0.83
Married/living as married	742 (78.8)	1.97 (0.92, 4.20)	96 (67.6)	1.41 (0.23, 8.60)	
Divorced/separated/widowed	159 (16.9)	1.34 (0.59, 3.05)	40 (28.2)	0.94 (0.14, 6.44)	
Educational attainment (years)					
<12	74 (7.9)	1.00 (referent)	11 (7.8)	1.00 (referent)	0.55
12	329 (34.9)	1.51 (0.84, 2.71)	55 (38.7)	0.48 (0.11, 2.17)	
>12	539 (57.2)	1.61 (0.92, 2.81)	76 (53.5)	0.61 (0.14, 2.72)	
Employment status					
Employed full- or part-time	430 (45.6)	1.00 (referent)	54 (38.0)	1.00 (referent)	0.19
Unemployed/disabled	144 (15.3)	0.95 (0.62, 1.47)	38 (26.8)	0.46 (0.19, 1.15)	
Retiree/volunteer	368 (39.1)	1.57 (1.16, 2.13)	50 (35.2)	0.87 (0.37, 2.03)	
Annual household income					
<\$30 000	314 (33.3)	1.00 (referent)	58 (40.8)	1.00 (referent)	0.57
\$30 000–\$60 000	317 (33.7)	2.03 (1.40, 2.94)	44 (31.0)	1.52 (0.63, 3.71)	
$\geq$ \$60 000	311 (33.0)	1.81 (1.24, 2.64)	40 (28.2)	1.37 (0.55, 3.42)	
Health insurance status					
Uninsured	78 (8.3)	1.00 (referent)	16 (11.3)	1.00 (referent)	0.38
Public insurance only	117 (12.4)	1.89 (0.91, 3.95)	25 (17.6)	7.88 (1.15, 53.84)	
Private insurance only	498 (52.9)	2.85 (1.54, 5.29)	65 (45.8)	5.75 (1.00, 33.12)	
Public and private insurance	249 (26.4)	4.97 (2.59, 9.53)	36 (25.3)	6.23 (1.08, 36.23)	
Smoking status					
Never	511 (54.3)	1.00 (referent)	74 (52.1)	1.00 (referent)	0.84
Former	329 (34.9)	1.05 (0.77, 1.43)	45 (31.7)	0.96 (0.43, 2.19)	
Current	102 (10.8)	0.68 (0.41, 1.11)	23 (16.2)	0.61 (0.20, 1.88)	
Health-related characteristics					
Have a regular primary care provider					
No	73 (7.8)	1.00 (referent)	5 (3.5)	1.00 (referent)	0.37
Yes	869 (92.2)	13.18 (3.29, 52.77)	137 (96.5)	3.94 (0.42, 37.34)	
Checkup in the past 2 years					
No	110 (11.7)	1.00 (referent)	8 (5.6)	1.00 (referent)	0.86
Yes	832 (88.3)	5.81 (3.02, 11.19)	134 (94.4)	7.15 (0.82, 62.61)	
Medical condition(s) requiring regular medical care					
No	314 (33.3)	1.00 (referent)	33 (23.2)	1.00 (referent)	0.65
Yes	628 (66.7)	1.34 (0.98, 1.83)	109 (76.8)	1.08 (0.44, 2.66)	
Self-rated health status					
Poor/fair	131 (13.9)	1.00 (referent)	29 (20.4)	1.00 (referent)	0.62
Good/very good/excellent	811 (86.1)	1.17 (0.77, 1.79)	113 (79.6)	1.51 (0.59, 3.83)	

Knowledge, communication and attitudes about CRC screening

**Table 1** Continued

	Very little worry, n = 942		Moderate-to-extreme worry, n = 142		P <sub>interaction</sub>
	n (%)	OR (95% CI) <sup>a</sup>	n (%)	OR (95% CI) <sup>a</sup>	
Aware that CRC screening should begin at age of 50 years					
No	423 (44.9)	1.00 (referent)	67 (47.2)	1.00 (referent)	0.43
Yes	519 (55.1)	1.12 (0.84, 1.48)	75 (52.8)	0.81 (0.38, 1.72)	
Ever encouraged by anyone (other than a physician) to have CRC screening test					
No/do not know	437 (46.4)	1.00 (referent)	60 (42.2)	1.00 (referent)	0.61
Yes	505 (53.6)	2.46 (1.81, 3.33)	82 (57.8)	1.99 (0.93, 4.27)	
Ever discouraged by anyone (other than a physician) from having CRC screening test					
No/do not know	905 (96.1)	1.00 (referent)	138 (97.2)	1.00 (referent)	0.98
Yes	37 (3.9)	0.82 (0.38, 1.76)	4 (2.8)	10 829.18 (0, ∞)	
Recommended by physician to be screened for CRC					
No/do not know	225 (23.9)	1.00 (referent)	18 (12.7)	1.00 (referent)	0.72
Yes	717 (76.1)	9.31 (5.40, 16.05)	124 (87.3)	13.60 (1.81, 102.51)	
Ever asked a physician to order a CRC screening test					
No/do not know	844 (89.6)	1.00 (referent)	117 (82.4)	1.00 (referent)	0.19
Yes	98 (10.4)	2.50 (1.46, 4.26)	25 (17.6)	1.19 (0.43, 3.29)	
Perceived risk of CRC (compared with others of the same gender and age) <sup>b</sup>					
Lower or similar perceived risk	834 (92.0)	1.00 (referent)	106 (79.8)	1.00 (referent)	0.74
Higher perceived risk	73 (8.0)	1.19 (0.71, 2.01)	32 (23.2)	1.01 (0.43, 2.36)	

<sup>a</sup>Multiple imputation was used to estimate OR (95% CI), given the proportion of missing data on income (16.4%) and within guidelines screening status by medical record review (34.2%).

<sup>b</sup>Perceived risk of CRC data missing on 39 participants (3.6%).

the mean ± standard deviation (SD) age of participants was 61.4 ± 6.8 years. Most were female (58.7%), white (96.8%), married/living as married (77.3%) and were high school graduates (92.1%). Similar proportions of participants were employed (44.6%) and retired/volunteers (38.6%). About half reported having private insurance (51.9%) and never smoking (54.0%). Most had a primary care provider (92.8%) and a checkup in the past 2 years (89.1%).

Higher CRC worry (moderate-to-extreme worry) was not significantly associated with adherence to CRC screening (OR = 1.32, 95% CI: 0.86–2.02), and CRC worry did not modify the association between any other predictor variable CRC screening behaviors. Employment status and perceived risk of CRC were the only significant correlates of moderate-to-extreme CRC worry (Table 2). Participants who were unemployed/disabled and retirees/volunteers (OR = 2.15, 95% CI: 1.34–3.45 and OR = 1.15, 95% CI: 0.76–1.76, respectively, compared with those who were employed) and who perceived themselves to be at higher CRC risk (OR = 3.49, 95% CI: 2.19–5.56, compared with those who perceived their risk

**Table 2** Multivariable logistic regression model for moderate-to-extreme CRC worry, n = 1084

	OR (95% CI)	P-value
Employment status		
Employed full- or part-time	1.00 (referent)	
Unemployed/disabled	2.15 (1.34–3.45)	0.002
Retiree/volunteer	1.15 (0.76–1.76)	0.50
Perceived risk of CRC (compared with others of the same gender and age) <sup>a</sup>		
Lower or similar perceived risk	1.00 (referent)	
Higher perceived risk	3.49 (2.19–5.56)	<0.0001

This model was constructed using backward selection of all variables associated with moderate-to-extreme CRC worry at the 0.2 significance level in bivariate analyses. When this model was constructed without perceived risk of CRC as an independent variable, given its strong correlation with CRC worry and the likelihood that perceived risk and CRC worry are similar outcomes, the results were unchanged.

<sup>a</sup>Perceived risk of CRC data missing on 39 participants (3.6%).

as the same or lower) had higher odds of moderate-to-extreme CRC worry. Given the strong association between perceived CRC risk and CRC worry observed through bivariate analysis and the likelihood that these variables represent similar outcomes, the multivariable-adjusted model of moderate-to-extreme CRC worry was also run without perceived risk as an independent variable, yielding similar findings. The association for employment status remained consistent (OR = 2.10, 95% CI: 1.33–3.32 and OR = 1.08, 95% CI: 0.72–1.63 for unemployed/disabled and retiree/volunteer, respectively).

## Discussion

### Main finding of this study

In this study of 1084 Ohio Appalachian residents, aged 51–75 years at average risk for CRC, we found that approximately half were adherent to guidelines for CRC screening according to their medical records, which is slightly lower than that estimated for the general US population (~60%).<sup>4</sup> Our findings demonstrated a lack of association between CRC worry and adherence to CRC screening, and that CRC worry did not modify the associations between other factors that were associated with adherence to CRC screening. Additionally, we found that perceived CRC risk and employment status were the only significant correlates of higher levels of CRC worry.

### What is already known on this topic

Contrary to two studies,<sup>6,7</sup> we have demonstrated no association between CRC worry and within guidelines CRC screening behaviors in a rural population. A recent study<sup>7</sup> of Chinese-American women showed that women who were worried about getting CRC were more likely to be screened within guidelines than those who were not worried about CRC (49 versus 29%,  $P = 0.0004$ ). Additionally, through multivariate analysis, CRC-specific worry was associated with approximately three times the odds of being screened within guidelines (OR = 2.79, 95% CI: 1.63–4.77).<sup>7</sup> In another study,<sup>6</sup> based on data from the Health Information National Trends Study, Moser *et al.* found that increased CRC worry was positively associated with having had a sigmoidoscopy or colonoscopy (OR = 1.32, 95% CI: 1.03–1.69 and OR = 1.43, 95% CI: 1.09–1.88, respectively), but not associated with having had an FOBT (OR = 1.00, 95% CI: 0.70–1.42).

Additionally, we observed a positive association between CRC worry and perceived risk of CRC, which suggests there may be a complex relationship between these constructs and CRC screening behaviors. In an earlier report, we observed that only 10% of average-risk Appalachian adults perceived

their CRC risk to be higher than others their age and gender<sup>11</sup> and found no association between perceived risk and CRC screening,<sup>11</sup> while other studies have reported a positive association.<sup>6,12–21</sup>

### What this study adds

There is no clear explanation for the lack of association between adherence to CRC screening and higher CRC worry in Appalachian adults. However, these data suggest that this population may generally underestimate their susceptibility to CRC. This underestimation may lead to a diminishing of the effect of worry on the decision to be screened for CRC. This is of interest given that participants included in these analyses were more likely to worry little about getting CRC, although rates of CRC incidence and mortality are known to be substantially higher among Appalachian versus non-Appalachian regions of the US.<sup>22</sup> We found that employment status and perceived CRC risk were the only factors associated with CRC worry, where participants who were unemployed or disabled had twice the odds of moderate-to-extreme worry compared with those who were employed and those who believed themselves to be at higher risk of CRC had triple the odds of moderate-to-extreme CRC worry than those with lower risk perceptions. These findings are supported by other studies;<sup>23,24</sup> however, ours is the first to report on Appalachian adults. These findings could have utility in the development and implementation of interventions to increase CRC screening uptake in this underserved community, which may benefit from programs that increase knowledge and awareness about general population risk, as well as specific risk of CRC within the Appalachian community, thereby potentially allowing members of this community to better appraise their own risk and make informed decisions about CRC screening.

### Limitations of this study

We note some limitations of this study. First, the cross-sectional design of the study limited the analysis of the mechanisms linking perceived risk and worry of developing CRC. It is apparent that these constructs are related; however, it may be helpful to know which occurs first and how the two contribute to CRC screening intentions and subsequent screening utilization. Additionally, we were underpowered to detect significant associations between within-guidelines CRC screening and CRC worry as well as interaction effects of CRC worry on other observed associations, given the small proportion of participants reporting moderate-to-extreme worry limited. Nonetheless, our findings make valuable contributions to the current literature on predictors of CRC screening utilization and CRC worry in a rural, underserved



population. Secondly, the response rate was not ideal (34.9%). However, this low rate of response is not unlike other epidemiological studies of similar design.<sup>25</sup>

In summary, this population-based study of adults, aged 51–75 years and at average risk for CRC, residing in Appalachian counties of Ohio has demonstrated that higher CRC worry was not a significant predictor of CRC screening test utilization. Additionally, our findings show that employment status and CRC risk perception were significantly associated with higher levels of CRC worry. These findings highlight the need for future studies to meaningfully explore the reasons that higher levels of CRC worry are not associated with adherence to CRC screening, particularly in rural and medically underserved populations. Further, development and implementation of interventions targeting CRC screening in these areas, given the disproportionate CRC burden, is a significant public health priority.

### Ethical approval

The Ohio State University Institutional Review Board approved this study, and all participants gave consent prior to study enrollment.

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