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Body mass index and screening for colorectal cancer: Gender and attitudinal factors

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Abstract

Background—Overweight/obese women and men are at increased risk for colorectal cancer (CRC) incidence and mortality. Research examining body mass index (BMI) and CRC screening has had mixed results. A clearer understanding of the extent to which high-BMI subgroups are screened for CRC is needed to inform planning for CRC screening promotions targeting BMI.

Methods—Data were obtained from a random, population-based sample of women and men at average-risk for CRC (aged 50–75 years) during 2004 (n=1098). Multiple logistic regression analyses were conducted to evaluate whether BMI category was significantly associated with the probability of reporting recent CRC screening and with the probability of agreeing with statements denoting attitudes/perceptions about CRC and screening. Attitudes/perceptions about CRC and screening were evaluated as potential mediators and moderators of the association between BMI category and CRC screening.

Results—After controlling for characteristics associated with CRC screening, overweight and obese women were each 40% less likely to have CRC screening than women with normal-BMI (OR=0.6, 95%CI:0.4–0.9 and OR=0.6, 95%CI:0.3–0.9). BMI category was unrelated to screening among men. Obese women (but not men) were less aware than normal-BMI women that obesity increased risk for CRC (OR=0.5, 95%CI:0.3–0.9) and less worried about CRC (OR=0.5, 95%CI: 0.3–0.8). However, findings suggest that attitudes/perceptions about CRC and screening did not mediate or moderate the association between BMI category and CRC screening.

Conclusion—Overweight/obese women are at increased risk for CRC because of their greater BMI and their propensity to not screen for CRC. Study findings suggest that potentially

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modifiable perceptions, e.g. lack of awareness of risk for CRC and less worry about CRC, in this subgroup may not explain the relationship between BMI category and reduced screening.

Keywords

Colorectal cancer screening tests; early detection; BMI; overweight; obesity gender; health behavior; attitude towards health

Colorectal cancer (CRC) is the second leading cause of cancer mortality in the United States[1]. CRC screening according to recommended guidelines with removal of precursor polyps detected through screening has been shown to decrease incidence and mortality for CRC.[2]. Although screening is widely recommended for average-risk adults starting at age 50[2–3], identification and targeting of high risk subgroups may maximize the benefits of early detection.

Health risks associated with overweight or obesity include increased risk for several cancers[4–5]. This includes higher risk for CRC incidence and mortality[4–11], as well as increased risk for colorectal adenomas which are precursors of CRC[12–15], among overweight and obese women and men compared to those with lower body weight. Given the substantial rate of overweight and obesity in the US – which in 2007–2008 attained 78% and 67% for men and women aged 40 years and over[16], targeting adults at higher risk for CRC due to BMI could potentially decrease CRC incidence and mortality in this population. [17]

A clearer understanding of the extent to which high risk BMI subgroups are screened for CRC is needed to inform planning for CRC screening promotions targeting BMI as a barrier to screening. The literature examining BMI and CRC screening has had mixed results[18]. Several studies suggest overweight and/or obese adults may be less likely to have CRC screening[12, 19–21]. Others note reduced screening with higher BMI among women but not men[22–23]. Leone et al.[24] found that obesity was associated with lower rates of colonoscopy among white women but not among African American women and suggest that some mixed findings may be due to the racial composition of the sample. Heo et al.[25] found that while BMI was not associated with FOBT use, screening sigmoidoscopy was more frequent among high BMI men but less frequent among high BMI women. Conversely, Slattery et al.[26] found greater sigmoidoscopy use among overweight and obese women (compared to those with normal weight) but not among overweight and obese men. A number of studies report no association between BMI and CRC screening[27–29].

We examined data from a sample of average risk adults age-eligible for screening to explore (1) whether BMI is associated with CRC screening and if it impacts screening differently among women and men; and (2) whether the BMI/CRC screening relationship is moderated or mediated by positive or negative attitudes and perceptions about CRC and CRC screening.

Methods

The research study protocol was approved by the Stony Brook University institutional review board and all study participants gave informed consent to their participation in this project.

Study participants

The population-based sample of women and men (aged 50–75 years) took part in the National Cancer Institute funded Reducing Barriers to Colorectal Cancer Screening project. All resided in five townships in Long island, NY. The sample was randomly drawn from lists of adults aged 50–64 years obtained from a commercial vendor (Research and Response, Inc., NY) and lists of adults aged 65–75 years obtained from the Centers for Medicare and Medicaid Services (Medicare enrollment files). Sample selection was stratified by township to ensure equal representation. Eligible participants were without a prior diagnosis of CRC, colonic polyps, or other colorectal diagnosis requiring surveillance rather than screening in the general population (e.g., ulcerative colitis, Crohn's Disease), were not too impaired to answer questions, and spoke English. Individuals with a family history of CRC were included in the sample. Details regarding this project, sample selection, and recruitment procedures have been previously published[30].

Data collection

Body mass index—(BMI; weight(kg)/height(m)²) was computed from self-reported height and weight. Standard World Health Organization categories of BMI[35] were defined as: underweight=BMI<18.5 kg/m²; normal=BMI 18.5–24.9 kg/m²; overweight=BMI 25–29.9 kg/m²; obese=BMI>=30 kg/m².

Perceptions about CRC and CRC screening—Respondents indicated whether they agreed, disagreed, or were undecided about statements denoting perceptions about risk for CRC, benefits, barriers and facilitators of screening, and screening exam-related benefits and barriers. Risk perception for CRC was evaluated with the statement: “Obesity increases risk for CRC”. Benefits, barriers, and facilitators of screening include: “How worried are you about getting CRC”; “Screening for CRC would give you a feeling of control over your health”; “Having screening for CRC causes a lot of worry and anxiety about CRC”; “You have so many other problems, that you can't be bothered with screening for CRC”; “You are more likely to have screening for CRC if your doctor told you it was important”. Screening exam-related benefits and barriers include: “Unpleasantness of doing an FOBT is bad enough to make you have second thoughts about getting one”; “The benefits of having CRC screening with colonoscopy outweigh any discomfort or difficulty you might have going through the test”.

Barriers to CRC screening—Open-ended questions addressed participants' perceived barriers to screening with FOBT, sigmoidoscopy, and colonoscopy. Those who did not have a recent screening exam were asked: “Why haven't you had a[n] [FOBT/sigmoidoscopy/colonoscopy] recently?” Respondents who had a recent exam but did not intend to have another were asked “Why don't you intend on having [regular FOBTs/sigmoidoscopy/

colonoscopy exams] in the future?” Participants who reported recent screening were also asked about potential barriers to the four CRC screening exam modalities, regardless of the type of most recent exam they reported: “What could keep you from having [regular FOBTs/sigmoidoscopy/colonoscopy exams] in the future?” Participant’s responses to these open-ended questions were recorded verbatim. Similar responses were grouped together (i.e., coded) under the range of categories used in the National Health Interview Survey (NHIS) - 2000 Cancer Module for CRC[27] to reduce the amount of data but still comprehensively evaluate the many potential barriers to screening. The range of NHIS categories denoting barriers to obtaining CRC screening are: “never thought of it”; “doctor didn’t order it”; “didn’t need it”; “have not had any problems”; “put it off”; “too expensive/no insurance”; “too painful, unpleasant, embarrassing”; “had another type of colorectal examination”; “don’t have a doctor”; “other”[27].

Participant demographic and health characteristics include self-reported age, gender, race/ethnicity, education, and family history of CRC. Current health status (poor, fair, good, very good, excellent) was included as a proxy for (potential) co-morbidities. Medical insurance coverage, regular health care provider and usual place of care, and visit to the physician in the past two years denote access/health care system factors which may facilitate CRC screening. Having a physician recommendation for CRC screening and whether that recommendation included a discussion about personal risk for CRC denote provider factors associated with screening completion.

Statistical analyses

Frequency distributions were examined for all study variables (which were categorical). Bivariate relationships between all participant characteristics, reports of recent CRC screening exam (yes vs. no), type of recent CRC screening exam and category of BMI were examined using crosstabular analyses and the chi square test of independence.

Because evidence suggests that associations between BMI and CRC screening differ among women and men[18, 22, 24–25], the gender by BMI category interaction was explored in the current sample using crosstabular analyses and Cochran’s and Mantel-Haenszel Tests of Conditional Independence. A significant gender by BMI category interaction was observed for CRC screening (described in the Results section), thus, subsequent bivariate and multivariate analyses were conducted separately for women and men.

Barriers to CRC screening among women and men were first examined using frequency distributions for FOBT, sigmoidoscopy, and colonoscopy to determine the proportion of women and men who reported any barrier to screening for each exam type. This was followed by crosstabular analyses of the proportion of women and men each reporting any barrier (vs. proportion who did not report any barrier) with BMI category. The chi square test of independence was used to evaluate the significance of the crosstabbed associations. Next, among women and men who reported a barrier, the category describing test characteristics was broken out for each type of screening exam. To explore whether reduced screening among the overweight or obese might be due to CRC screening exam features (e.g., embarrassment, pain, unpleasant, etc.), proportions of women and men citing barriers related to test characteristics by category of BMI was examined as described above.

Multiple logistic regression analyses were conducted to evaluate whether category of BMI (overweight and obese vs. normal (referent)) was significantly associated with the probability of reporting any recent CRC screening exam (yes vs. no). Participant characteristics noted in the literature to be associated with CRC screening were included as covariates. Consequently, age, education, race/ethnicity, medical insurance, health status, family history of CRC, regular health care provider and usual place of care, visiting the physician in the past 2 years, physician recommendation for CRC screening and discussing personal risk for CRC with the physician were entered first as a block, regardless of whether they were significantly related to the dependent variable (i.e., recent CRC screening) in the cross-tabular analyses. This was because independent variables which may not be significantly associated with a dependent variable at the bivariate level may become significantly related to the dependent variable when considered together in a multivariate model and to avoid biasing estimates of other potential covariate effects[36]. The variable denoting category of BMI was entered on the second block to evaluate its unique contribution to the explanatory power of the model.

Multiple logistic regression analyses were also conducted to evaluate whether category of BMI (overweight, and obese vs. normal (referent)) was significantly associated with the probability of agreeing (vs. not agree) with statements denoting perceptions about CRC and screening (e.g., perceptions of CRC risk CRC, barriers and facilitators of CRC screening, etc.) These models were adjusted for covariates related to screening, as described above. Perceptions about CRC and screening were also evaluated as potential moderators of the association between BMI category and CRC screening by including interaction terms for these and BMI category in the regression models. Moderator or interaction effects evaluate whether the strength or direction of an association between category of BMI and CRC screening differs according to whether respondents at each level of BMI agree or do not agree with a perception statement[37]. For example, are obese or overweight respondents less likely to report recent CRC screening when they do not agree that obesity increases risk for CRC and more likely to report recent CRC screening when they agree that obesity increases risk for CRC, compared to normal BMI respondents who agree with that risk perception statement. Put another way, agreement/disagreement with the perception statements as moderators of the relationship between BMI category and CRC screening may potentially specify the condition when the relationship between BMI category and reduced screening is most likely[37].

Adjusted odds ratios (OR) and 95% confidence intervals (CI) were computed from the regression coefficients and standard errors were estimated by the Wald test[36]. All tests of significance were two-sided, and evaluated at the $p < 0.05$ level. Analyses described above were performed using the Statistical Package for the Social Sciences (SPSS, IBM Version 19).

Lastly, perceptions about CRC and screening were evaluated as potential mediators of the association between BMI category and CRC screening. Mediation analyses provide an understanding of the process by which one variable affects another to influence an outcome, rather than just describe relationships among variables[38, 39]. A variable is described as a mediator “...to the extent that it accounts for the relation between the predictor and the

criterion” [37]. That is, mediators suggest why a relationship occurs[37]. We applied a simple mediation model to evaluate whether perceptions about CRC and CRC screening mediate (or explain) the relationship between BMI category (the predictor) and CRC screening (the criterion). This was accomplished by conducting logistic regression models to (1) estimate the regression coefficient describing the relationship between BMI category and reported CRC screening (path a) and (2) to estimate regression coefficients describing relationships between each perception about CRC and CRC screening item and reported CRC screening (path b) [38]. [NOTE: the potential mediation effect of each perception item was evaluated using separate models for each]. Next, the regression coefficient for the indirect effect (path c’: BMI category indirectly influencing CRC screening through perceptions about CRC and CRC screening) was estimated by calculating the product of the standardized coefficients for the regression models describing path a and path b [38]. Finally, the significance of this indirect path (i.e., is it significantly different from zero) was evaluated using bootstrap methods [38, 39]. Bootstrapping is a nonparametric procedure for estimating effect size and testing hypotheses [40], provides greater power with small samples [38] and yields bias-corrected 95% CIs for the indirect effects (CIs for significant indirect effects do not contain zero)[41].

Because the independent, mediator and outcome variables are all binary and because logistic regression models yield regression coefficients with different scales [42], the statistical package STATA[43] was used to obtain standardized regression coefficients for the mediation analyses.

Results

Cross-tabular analyses: demographic and health characteristics by category of BMI

The sample for these analyses is comprised of 1098 respondents. Ten respondents (0.9%) who were underweight ($BMI < 18.5 \text{ kg/m}^2$ [35]) were excluded from all analyses. As shown in Table 1, 34% of respondents had BMI in the normal range, 42% were overweight and 25% were obese. Category of BMI was significantly associated with age group, gender, and level of education (all p 's < 0.01).

The proportion of respondents who were up to date with CRC screening – that is, reported any recent CRC screening exam - decreased as category of BMI increased (p for trend = 0.02). That is, while 67% of obese respondents reported being up to date (with any recent screening exam), 72% of overweight and 76% of normal BMI respondents were up to date with any recent screening exam. Type of most recent CRC screening exam also varied by category of BMI, with a smaller proportion of obese respondents who were up to date with screening reporting recent colonoscopy but a greater proportion reporting sigmoidoscopy alone or FOBT + sigmoidoscopy, than normal-weight or overweight respondents (p for trend = 0.01). However, when recent colonoscopy or sigmoidoscopy were combined (i.e., recent endoscopy), the proportion of respondents reporting a recent endoscopy exam did not vary by category of BMI (p for trend = 0.59; data not shown).

Twenty one percent of obese respondents reported poor-fair health status relative to 13% of overweight and 8% of normal weight respondents. Whereas, 35% of obese respondents

reported very good-excellent health status relative to those who were overweight (48%) and those of normal weight (59%), ($p < 0.01$ for the category of BMI by category of health status comparison). Family history of CRC, regular health care provider usual place of care, visiting the physician in the past two years, or discussion of individual risk for CRC with the physician were statistically similar for all BMI subgroups. However, a smaller proportion of obese respondents reported a physician recommendation for CRC screening, than those who were overweight or normal weight ($p = 0.01$).

A significant BMI category by gender interaction was observed for utilization of CRC screening ($p < 0.002$) and all subsequent analyses (see below) were conducted separately for women and men.

Multivariate logistic regression analyses: Predictors of CRC screening utilization among women and among men

Results of multiple logistic regression models assessing the effect of BMI category on recent CRC screening exam after adjusting for covariates, are shown in Table 2. The full models containing all predictors (including BMI), for women and for men, were statistically significant ($X^2(18, n=599) = 109.9, p < 0.0001$ and $X^2(19, n=461) = 106.7, p < 0.0001$, respectively). The full models are able to distinguish between respondents who reported a recent CRC screening exam and those who did not. The full model for women correctly classified 74.5% of cases and the full model for men correctly classified 80.5% of cases.

Physician recommendation for CRC screening with a discussion of the respondent's personal risk for CRC, emerged as the strongest predictor of any recent screening exam among women and among men. Women and men who did not report a physician recommendation with risk discussion were each 90% less likely to have screening than respondents who did (p 's < 0.001). Women who reported poor-fair health status were 2 times more likely to report recent screening, compared to women who reported very good-excellent health status ($p = 0.04$). Men with Medicare/Medicaid health insurance (vs. other commercial insurance) and men who did not visit their physician in the past 2 years were 80% less likely to have had recent screening (p 's $= 0.01$ and 0.03 , respectively).

Even so, after adjusting for all covariates including physician recommendation for CRC screening/discussion of personal risk for CRC, BMI category significantly subtracted from having recent CRC screening and significantly added to the explanatory power of the model ($X^2(2)$ for the -2 Log Likelihood change $= 6.67, p = 0.04$) among women. As seen in Table 2, women who were overweight or obese were each 40% less likely than women with BMI in the normal range to report any recent CRC screening ($p = 0.02$ and $p = 0.04$, respectively). BMI category however, was not associated with CRC screening among men in the multivariate model and did not contribute significantly to the overall model ($X^2(2)$ for the -2 Log Likelihood change $= 0.09, p = 0.95$).

Barriers to CRC screening with FOBT, sigmoidoscopy and colonoscopy, among women and among men (data not shown)

Overall, 52% of women (n=321) and 47% of men (n=220 men) cited a barrier to CRC screening with FOBT; 80% of women (n=497) and 69% of men (n=334) cited a barrier to CRC screening with sigmoidoscopy; and 52% of women (n=326) and 45% of men (n=206) men cited a barrier to CRC screening with colonoscopy. However, proportions of women and men citing any barrier to FOBT, sigmoidoscopy or colonoscopy did not vary significantly by category of BMI (all p 's>0.25).

Among those who cited a barrier to FOBT, 12% (n=37) of women and 13% (n=29) of men cited a barrier related to test characteristics (e.g., test is disgusting, embarrassing, don't like idea of the test, etc). Among those who cited a barrier to sigmoidoscopy, 15% (n=76) of women and 11% (n=35) of men cited a barrier related to test characteristics (e.g., test is disgusting, embarrassing, don't like idea of the test, pain, afraid of test, etc). Among those who cited a barrier to colonoscopy, 29% (n=95) of women and 18% (n=38) of men cited similar barriers related to test characteristics. Regardless of gender, proportions of barriers to FOBT, sigmoidoscopy or colonoscopy describing test characteristics did not differ by BMI category (all p 's>0.12).

Multivariate logistic regression analyses: Perceptions about CRC, CRC screening and category of BMI, among women and among men

As shown in Table 3, after controlling for all other characteristics, women who were obese were half as likely as women with normal-range BMI, to agree that obesity increases risk for CRC ($p=0.03$) and to report worry about getting CRC ($p<0.01$); they were 40% less likely to agree that screening causes worry and anxiety about CRC ($p=0.05$). Women who were overweight were 60% less likely to agree that other problems preclude screening for CRC ($p=0.01$) and were 2.6 times more likely to agree that they would screen for CRC if their physician said it was important ($p=0.01$), compared to women with normal BMI. Agreement with these statements did not vary by BMI category among men.

Attitudes about whether the unpleasantness of FOBT or discomfort of colonoscopy outweigh the benefits or whether the discomforts of these exams precluded getting one, did not vary with category of BMI among women. Only obese men were more likely than normal-weight men, to agree that colonoscopy was uncomfortable enough to make them have second thoughts about getting one ($p=0.04$).

Moderating and mediating effects of perceptions about CRC and screening on the relationship between BMI category and CRC screening, among women and among men (data not shown)

Perceptions noted above, did not moderate the relationship between BMI category and CRC screening. All interaction terms for category of BMI and participant attitudes and perceptions toward CRC and screening were not significantly associated with the likelihood of reporting a recent CRC screening exam, regardless of gender, in the multiple logistic regression models.

Additionally, no significant indirect effects of participant perceptions about CRC and screening, on the relationship between category of BMI and CRC screening were found suggesting that participant perceptions do not mediate (i.e., explain) the relationship between BMI category and CRC screening.

Discussion

We found that overweight and obese women were significantly less likely to have CRC screening than women of normal weight, however this variation by BMI category did not apply to men. Specifically, women who were overweight and those who were obese were each 40% less likely to report any recent CRC screening, after controlling for other influential predictors of CRC screening such as receiving a physician recommendation. Our results are congruent with prior literature suggesting that BMI within the overweight and obese range is significantly associated with a lower likelihood of screening for CRC, among women only[22–23, 25].

We also found that obese women were significantly less aware than normal weight women that obesity increased risk for CRC, and related to this less worried about CRC, despite growing epidemiological data associating greater BMI with increased risk CRC among women, in evidence at the time that our study was conducted[10, 44–46]. Low awareness of obesity as a risk factor for CRC and less worry about CRC did not, however, explain the relationship between BMI category and screening, but rather higher BMI category appears to influence women's CRC screening behaviors independent of perceived risk and worry in our sample of women[47].

Obesity in the US continues to escalate and awareness of overweight and obesity as a CRC risk remains low in the general population[48] and among those with high BMI[49]. Low perceived risk for CRC in concert with less worry about CRC is associated with intentions not to screen[50–51]. Thus, our findings suggest the potential value of targeting interventions to increase awareness of the need for CRC screening and for reducing body weight among women most at risk for obesity-related CRC and among their physicians. Such interventions should include a dialogue about weight-related risk for CRC and the consequent need for CRC screening during office visits, particularly since we found that fewer obese adults, compared to those of normal weight, reported receiving a physician recommendation for CRC screening, similar to others[23], and obese women in our sample were receptive to following physician recommendations to have CRC screening. They were also less likely than women with normal BMI, to feel that having screening would cause them to worry or be anxious about finding CRC. Evidence suggests that targeting positive anticipatory affective beliefs may be useful for reducing risky behaviors (e.g., not screening for CRC)[52] – these beliefs can be reinforced during patient/physician dialogs about CRC screening.

Although not fully investigated, some studies have found that barriers to CRC screening, especially with endoscopy exams, differ among women and men with women expressing more concerns about embarrassment and exposure[53–55]. Because these concerns may be more significant to overweight/obese women than overweight/obese men, it has been

suggested by others that this may account for reduced CRC screening among high-BMI women. However, we found that relatively few respondents reported barriers to screening which relate to the negative aspects of screening exams such as embarrassment, pain, fear, and discomfort. Moreover, these barriers did not vary by BMI category among women. Overweight men were, on the other hand, more likely than normal-weight men to express the concern that the discomfort of colonoscopy was enough to prevent them from having one.

Speculation about why screening for CRC is lower among overweight and obese women but not overweight and obese men has also focused on socio-economic, health care access, and health-priority barriers. It has been suggested that obese adults more frequently experience barriers to health care access that are related to socio-economic disadvantage, such as less education and income and inadequate health insurance[22, 56]. Although, obesity appears to be more prevalent among women with less education and low income, than similarly disadvantaged men[57] this is unlikely to account for our finding of less screening in this group because we controlled for factors impacting access to health care in the adjusted analyses. The large majority of women and men in our sample reported socio-demographic and health care characteristics conducive to CRC screening – i.e., mostly white, higher education and income, private health insurance, regular health care provider and usual place of health care, recent visit to physician. None the less, our findings suggest that efforts to improve CRC screening among men (regardless of BMI category) are indicated, particularly targeting those on Medicare or Medicaid who infrequently visit their physician.

Adults with higher BMI more frequently experience co-morbidities[58–60] which may preempt CRC screening as a health priority. Although we included health status as a proxy for comorbidity in the adjusted analyses, in general, comorbidity appears to affect women and men equally[61] and therefore would not plausibly contribute to BMI-related gender differences in CRC screening. Interestingly, obese women in our sample were less likely than those of normal weight to agree that having other problems would prevent them from getting CRC screening.

Limitations of this study include small numbers of African American participants (especially among women) in our study sample which reduced the adequacy of our study to examine whether race moderated the relationship between BMI category and CRC screening in our sample, as suggested by Leone et al.[24] Self-reported data were obtained from a relatively homogenous local sample of adults who were largely White, educated, and with adequate medical insurance coverage, which limits the generalizability of study results. Self-reported CRC screening is associated with over-reporting of screening by respondents[62]. In general, self-reported height is overestimated while weight tends to be underestimated resulting in underestimation of BMI, more so for women than men[63]. However, the presence of these reporting biases for CRC screening and BMI would likely attenuate the magnitude of differences detected in our study. Other limitations include the cross-sectional study design which precludes inferences about causal relationships among study variables because findings are correlational and the direction of relationships is unknown (a limitation of the cross-sectional nature of the mediation analysis as well).

In summary, women who are overweight or obese are at increased risk for CRC because of their greater BMI and their propensity to not screen for CRC, which is independent of test-related, socio-economic, health care access, and health-priority factors[19, 22–23, 56]. Although obese women (but not men) were less aware than normal-BMI women of the risk for CRC conveyed by obesity and were also less worried about CRC, our findings suggest that these potentially modifiable perceptions may not explain the relationship between BMI category and reduced screening. While other studies have identified perceived barriers to CRC screening that are reported more frequently when level of BMI is high, to our knowledge we have conducted the first exploration of whether BMI-related perceptions of barriers to CRC screening explain the BMI - CRC screening relationship. Further investigation is clearly warranted to determine whether our null mediation findings replicate with other samples. Continued research in this area is needed to fully describe the process by which BMI influences CRC screening in order to better inform interventions targeted to women and physicians to improve CRC outcomes related to BMI.

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TABLE 1

Demographic and health characteristics of the sample by BMI category (n = 1098).

	Overall sample	BMI category						p*	
		Normal		Overweight		Obese			
		18.5 – 24.9 (34%; n = 371)	% (n)	25 – 29.9 (42%; n = 456)	% (n)	30 (25%; n = 271)	% (n)		
Demographic characteristics									
Age		%	(n)	%	(n)	%	(n)	%	(n)
50–64 years	45	(490)	43	(158)	41	(188)	53	(144)	<0.01
65 + years	55	(603)	57	(210)	59	(267)	47	(126)	
Gender									<0.01
Female	57	(623)	68	(251)	49	(225)	54	(147)	
Male	43	(475)	32	(120)	51	(231)	46	(124)	
Race/ethnicity									0.26
White NH	92	(1001)	94	(342)	92	(418)	90	(241)	
African American NH	5	(53)	4	(15)	5	(21)	6	(17)	
Hispanic	2	(21)	1	(3)	2	(9)	3	(9)	
Other NH	1	(13)	1	(5)	1	(6)	1	(2)	
Education									<0.01
< High school	5	(56)	5	(18)	5	(22)	6	(16)	
High school graduate	27	(296)	23	(84)	30	(135)	28	(77)	
Post high school	29	(316)	25	(91)	30	(139)	32	(86)	
College +	39	(426)	48	(175)	35	(160)	34	(91)	
Medical Insurance									0.28
None	3	(34)	4	(16)	2	(9)	3	(9)	
Medicare/Medicaid	5	(56)	4	(15)	6	(27)	5	(14)	
HMO/other commercial	92	(1001)	92	(339)	92	(415)	92	(247)	
Health characteristics									
Any recent CRC screening exam	72	(788)	76	(280)	72	(330)	67	(178)	0.02**

	Overall sample	BMI category						p*
		Normal		Overweight		Obese		
		18.5 – 24.9 (34%; n = 371)	% (n)	% (n)	25 – 29.9 (42%; n = 456)	% (n)	30 (25%; n = 271)	
Recent CRC screening modality (n = 784)								
Colonoscopy	56	(441)	57	(159)	59	(195)	49	(87)
FOBT	24	(193)	27	(75)	24	(79)	22	(39)
Sigmoidoscopy	11	(87)	9	(26)	9	(31)	17	(30)
FOBT + sigmoidoscopy	5	(37)	4	(12)	4	(13)	7	(12)
Double contrast barium enema	4	(30)	3	(8)	4	(12)	6	(10)
Health status								
Poor – fair	13	(144)	8	(28)	13	(61)	21	(55)
Good	38	(417)	33	(122)	39	(178)	44	(117)
Very good – excellent	49	(530)	59	(217)	48	(221)	35	(92)
No family history CRC	90	(993)	91	(339)	90	(418)	90	(236)
Regular health care provider and usual place of health care	95	(1043)	95	(350)	97	(439)	94	(254)
Visit to physician in past 2 years (yes)	97	(1066)	97	(360)	98	(446)	96	(260)
MD recommendation for CRC screening	75	(820)	76	(281)	78	(355)	68	(184)
MD discussed risk for CRC	38	(165)	37	(57)	41	(75)	35	(33)
0.01**								

NOTE: Percentages are based on slightly different sample sizes due to missing values within each characteristic.

* p for BMI categories by characteristic comparison

** p's for linear trend: BMI categories by recent screening exam and CRC screening modality comparison

Table 2

Respondent characteristics associated with reporting a recent CRC screening exam (n = 1098).

Predictor	Had recent CRC screening exam (yes vs. no)			
	Women (n = 623)		Men (n = 475)	
	Adj. OR (95% CI)	p	Adj. OR (95% CI)	p
Age				
50–64 years	0.9 (0.6, 1.3)	0.48	0.8 (0.4, 1.3)	0.33
>= 65 years (ref)	1.0		1.0	
Race/ethnicity*				
African American NH	1.8 (0.8, 4.0)	0.17	1.0 (0.3, 3.4)	0.99
Other NH	----	---	3.6 (0.2, 69.3)	0.40
Hispanic	1.2 (0.4, 4.3)	0.74	0.3 (0.1, 2.5)	0.31
White (ref)	1.0		1.0	
Education				
< High school	0.4 (0.2, 1.2)	0.11	0.8 (0.3, 2.3)	0.67
High school grad	0.7 (0.4, 1.1)	0.15	0.7 (0.4, 1.5)	0.40
Post high school	0.9 (0.6, 1.5)	0.75	1.1 (0.6, 2.1)	0.71
College + (ref)	1.0		1.0	
Medical insurance				
No insurance	0.5 (0.2, 1.6)	0.27	1.1 (0.2, 5.5)	0.94
Medicare/Medicaid	0.6 (0.2, 1.3)	0.20	0.2 (0.1, 0.7)	0.01
Other commercial insurance (ref)	1.0		1.0	
Health status				
Poor – fair	2.0 (1.0, 3.7)	0.04	0.7 (0.3, 1.6)	0.46
Good	1.1 (0.8, 1.8)	0.52	0.7 (0.4, 1.2)	0.16
Very good – excellent (ref)	1.0		1.0	
Family history CRC (yes)	1.5 (0.7, 3.4)	0.29	2.3 (0.9, 6.1)	0.09
No family history (ref)	1.0		1.0	
Visit to MD in past 2 years (no)	0.5 (0.1, 1.9)	0.28	0.2 (0.1, 0.9)	0.03
Yes (ref)	1.0		1.0	
Regular MD/usual place of care (no)	0.9 (0.3, 2.4)	0.85	0.6 (0.2, 2.0)	0.44
Yes (ref)	1.0		1.0	
MD recommendation for CRC screening/MD discussed personal risk for CRC				
No recommendation/no risk discussion	0.1 (0.1, 0.2)	<0.001	0.1 (0.1, 0.2)	<0.001
No recommendation/yes risk discussion	0.5 (0.2, 1.1)	0.07	0.7 (0.3, 1.5)	0.33
Yes recommendation/yes risk discussion (ref)	1.0		1.0	
BMI category				
Overweight	0.6 (0.4, 0.9)	0.02	0.9 (0.5, 1.7)	0.84
Obese	0.6 (0.3, 0.9)	0.04	0.9 (0.5, 1.9)	0.90
Normal (ref)	1.0		1.0	

* Only 6 respondents comprised the Other NH category among women – these were combined with the African American NH group for the regression model.

NOTE: Adj OR = adjusted odds ratio; odds ratios are adjusted for all listed predictors. Significant results are bolded.

Table 3

Perceptions about CRC and CRC screening and category of BMI (n = 1098).

Perceptions about risk for CRC				
<i>Obesity increases risk for CRC (agree vs. does not agree)</i>				
	Women (n = 623)		Men (n = 475)	
	Adj. OR* (95% CI)	p	Adj. OR* (95% CI)	p
BMI category				
Overweight	0.7 (0.4, 1.3)	0.30	1.0 (0.5, 2.1)	0.37
Obese	0.5 (0.3, 0.9)	0.03	0.7 (0.3, 1.5)	0.37
Normal (ref)	1.0		1.0	
Perceived benefits, barriers, and facilitators of CRC screening				
<i>How worried are you about getting CRC (worried vs. not worried)</i>				
	Women (n = 623)		Men (n = 475)	
	Adj. OR* (95% CI)	p	Adj. OR* (95% CI)	p
BMI category				
Overweight	0.9 (0.6, 1.4)	0.70	0.8 (0.5, 1.3)	0.46
Obese	0.5 (0.3, 0.8)	<0.01	1.0 (0.6, 1.8)	0.93
Normal (ref)	1.0		1.0	
<i>Having screening for CRC causes a lot of worry or anxiety about CRC (agree vs. does not agree)</i>				
	Women (n = 623)		Men (n = 475)	
	Adj. OR* (95% CI)	p	Adj. OR* (95% CI)	p
BMI category				
Overweight	0.9 (0.6, 1.4)	0.63	1.2 (0.7, 2.1)	0.43
Obese	0.6 (0.4, 1.0)	0.05	1.3 (0.7, 2.4)	0.48
Normal (ref)	1.0		1.0	
<i>Having a screening test for CRC is just looking for trouble (agree vs. does not agree)</i>				
	Women (n = 623)		Men (n = 475)	
	Adj. OR* (95% CI)	p	Adj. OR* (95% CI)	p
BMI category				
Overweight	0.4 (0.2, 1.1)	0.09	1.3 (0.5, 3.5)	0.64
Obese	0.9 (0.3, 2.3)	0.07	0.8 (0.2, 3.9)	0.73
Normal (ref)	1.0		1.0	
<i>Having screening for CRC would give you a feeling of control over your health (agree vs. does not agree)</i>				
	Women (n = 623)		Men (n = 475)	
	Adj. OR* (95% CI)	p	Adj. OR* (95% CI)	p
BMI category				

Perceptions about risk for CRC

Obesity increases risk for CRC (agree vs. does not agree)

	Women (n = 623)		Men (n = 475)	
	Adj. OR* (95% CI)	p	Adj. OR* (95% CI)	p
Overweight	0.9 (0.5, 1.6)	0.80	0.7 (0.4, 1.4)	0.36
Obese	0.6 (0.3, 1.2)	0.14	1.7 (0.7, 4.0)	0.22
Normal (ref)	1.0		1.0	

You have so many other problems that you can't be bothered with screening for CRC (agree vs. does not agree)

	Women (n = 623)		Men (n = 475)	
	Adj. OR* (95% CI)	P	Adj. OR* (95% CI)	P
BMI category				
Overweight	0.4 (0.2, 0.8)	0.01	1.5 (0.7, 3.4)	0.32
Obese	1.0 (0.5, 2.0)	0.98	0.8 (0.3, 2.0)	0.78
Normal (ref)	1.0		1.0	

You are more likely to have CRC screening if your doctor said it was important for you (agree vs. does not agree)

	Women (n = 623)		Men (n = 475)	
	Adj. OR* (95% CI)	P	Adj. OR* (95% CI)	P
BMI category				
Overweight	2.6 (1.2, 5.4)	0.01	0.4 (0.2, 1.2)	0.13
Obese	1.2 (0.6, 2.5)	0.56	0.6 (0.2, 1.9)	0.34
Normal (ref)	1.0		1.0	

Perceived CRC screening exam-related benefits and barriers

The benefits of having CRC screening with FOBT outweigh any discomfort/difficulty you might have doing the test (agree vs. does not agree)

	Women (n = 623)		Men (n = 475)	
	Adj. OR* (95% CI)	P	Adj. OR* (95% CI)	P
BMI category				
Overweight	0.8 (0.4, 1.3)	0.31	0.7 (0.4, 1.4)	0.39
Obese	0.9 (0.5, 1.8)	0.84	1.4 (0.6, 3.1)	0.45
Normal (ref)	1.0		1.0	

The unpleasantness of doing an FOBT is bad enough to make you have second thoughts about getting one (agree vs. does not agree)

	Women (n = 623)		Men (n = 475)	
	Adj. OR* (95% CI)	P	Adj. OR* (95% CI)	P
BMI category				
Overweight	1.4 (0.8, 2.3)	0.20	1.4 (0.5, 1.5)	0.29
Obese	1.2 (0.7, 2.2)	0.45	1.4 (0.5, 1.4)	0.35
Normal (ref)	1.0		1.0	

Perceptions about risk for CRC*Obesity increases risk for CRC (agree vs. does not agree)*

	Women (n = 623)		Men (n = 475)	
	Adj. OR* (95% CI)	p	Adj. OR* (95% CI)	p
<i>The benefits of having CRC screening with colonoscopy outweigh any discomfort/difficulty you might have going through the test (agree vs. does not agree)</i>				
	Women (n = 623)		Men (n = 475)	
	Adj. OR* (95% CI)	p	Adj. OR* (95% CI)	p
BMI category				
Overweight	1.0 (0.6, 1.7)	0.92	0.6 (0.3, 1.2)	0.15
Obese	0.9 (0.5, 1.7)	0.80	0.9 (0.4, 2.1)	0.89
Normal (ref)	1.0		1.0	

Having a colonoscopy is uncomfortable enough to make you have second thoughts about getting one (agree vs. does not agree)

	Women (n = 623)		Men (n = 475)	
	Adj. OR* (95% CI)	p	Adj. OR* (95% CI)	p
BMI category				
Overweight	0.8 (0.5, 1.2)	0.23	1.8 (1.0, 3.3)	0.04
Obese	0.9 (0.6, 1.6)	0.82	0.8 (0.4, 1.6)	0.51
Normal (ref)	1.0		1.0	

* Adjusted odds ratios for category of BMI adjusted for age, race/ethnicity, education, medical insurance, health status, family history of CRC, visit to physician in the past 2 years, regular physician/usual place of care, and physician recommendation for CRC screening/discussion of personal risk for CRC.

NOTE: Significant results are bolded