Colorectal Cancer Screening Disparities Related to Obesity and Gender

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BACKGROUND: **Obesity is associated with a higher incidence of colorectal cancer and increased colorectal cancer mortality. Obese women are less likely to undergo breast and cervical cancer screening than nonobese women. It is not known whether obesity is associated with a lower likelihood of colorectal cancer screening.**

OBJECTIVE: **To evaluate whether there is an association between body mass index (BMI) and rates of colorectal cancer screening. To examine whether BMI-related disparities in colorectal cancer screening differ between men and women.**

DESIGN AND SETTING: **The Behavioral Risk Factor Surveillance System, a cross-sectional random-digit telephone survey of noninstitutionalized adults conducted by the Centers for Disease Control and Prevention and state health departments in the 50 states and Washington, DC in 1999.**

PATIENTS: **Survey respondents (*N* = 52,886) between 51 and 80 years of age representing 64,563,332 U.S. adults eligible for colorectal cancer screening.**

INTERVENTIONS AND MEASURMENTS: **Adjusted rates of self-reported colorectal cancer screening with fecal occult blood testing within the past year or endoscopic screening (sigmoidoscopy or colonoscopy) within the past 5 years.**

RESULTS: **The colorectal cancer screening rate was 43.8% overall. The rate of screening by FOBT within the last year or endoscopic screening within the past 5 years was 39.5% for the morbidly obese group, 45.0% for the obese group, 44.3% for the overweight group, and 43.5% for the normal weight group. The difference in screening rates was entirely attributable to differences in BMI among women. After statistical adjustment for potential confounders, morbidly obese women were less likely than normal weight women to be screened (adjusted rate difference, –5.6%; 95% confidence interval, –8.5 to –2.6). Screening rates among normal weight, overweight, and obese women, and among men in different weight groups did not differ significantly.**

CONCLUSIONS: **Colorectal cancer screening rates among age-eligible persons in the U.S. are disturbingly low. Morbidly obese women, who are at higher risk than others to develop and to die from colorectal cancer, are less likely to be screened. Efforts to increase colorectal cancer screening are needed for all age-eligible groups, but should also include targeted screening of morbidly obese women since they could reap substantial clinical benefits from screening.**

KEY WORDS: **colorectal cancer screening; obesity; disparities; gender; quality of care.**
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Colorectal cancer is the second leading cause of cancer death in the United States. Approximately 152,200 new cases and 57,100 deaths are projected for 2002. If patients are diagnosed and treated when the disease is localized, approximately 90% of patients will survive at least 5 years. However, only 37% of colorectal cancers are discovered at this localized stage.[1] Despite the efficacy of a variety of colorectal cancer (CRC) screening tests for detecting precancerous polyps or localized disease and reducing CRC mortality,[2–8] the majority of adults over 50 years of age do not receive appropriate CRC screening.[9,10]

Compared to others, obese individuals have a higher risk of developing colorectal cancer[11–18] and a higher colorectal cancer associated mortality.[19,20] The number of Americans with obesity has grown rapidly over the last decade. Nearly 20% of the U.S. population met criteria for obesity in 2000.[21] Because this group is at high risk, failure to screen could result in substantial morbidity and mortality. In prior studies, obese women were less likely than others to receive screening for breast and cervical cancer.[22–24] No study to date has examined whether obese populations are less likely to receive colorectal cancer screening or whether body mass index (BMI)-related disparities in cancer screening affect men as well as women.

We undertook this study to examine whether obesity is associated with lower colorectal cancer screening rates. We used nationally representative data from the 1999 Behavioral Risk Factor Surveillance System (BRFSS) to test the hypothesis that obese persons would receive lower rates of CRC screening than others. We also tested the hypothesis that obese men would be less likely than nonobese men to receive colorectal cancer screening.

METHODS

Study Sample

The BRFSS is a federally funded telephone survey conducted annually by state health departments in conjunction with the Centers for Disease Control and Prevention.[25] Each state surveys a probability sample of noninstitutionalized adults aged ≥18 years using a random-digit dialing

protocol. The survey asks about health-related behaviors and risk factors related to 1 or more of the 10 leading causes of mortality in the United States. Interviews are conducted in English or Spanish and data collected in each state are weighted to provide nationally representative estimates. In 1999, all 50 states, the District of Columbia, and Puerto Rico participated in the survey, with a total of 159,989 respondents. The median state response rate, based on individuals actually reached by telephone, was 68.4%.[26]

We selected 56,861 adults who completed the 1999 BRFSS survey who were considered eligible for colorectal cancer screening based on age 50 to 80 years. We excluded 1,052 respondents (2.3%) who did not know or refused to report their colorectal cancer screening status, and 2,027 respondents (3.6%) who did not report their height or weight. We excluded the 896 (1.6%) individuals with a BMI < 18.5 kg/m^2 (underweight by World Health Organization criteria) and those greater than 80 years of age because serious comorbid illness or limited life expectancy might make colorectal cancer screening inappropriate for a substantial percentage of these 2 groups. The final sample included 52,886 respondents.

Definitions

Colorectal Cancer Screening. Several national guidelines recommend that all individuals ≥50 years old undergo one of several screening strategies including annual fecal occult blood test (FOBT), sigmoidoscopy every 5 years, or a combination of annual FOBT and sigmoidoscopy every 5 years.[27–29] Other recommended screening options include colonoscopy every 10 years or double-contrast barium enema every 5 to 10 years.[27,29]

In 1999, all BRFSS survey respondents ≥ 50 years were asked about screening with FOBT and sigmoidoscopy or colonoscopy (hereafter referred to as endoscopic screening). For FOBT, respondents were asked, "A blood stool test is a test that may use a special kit at home to determine whether the stool contains blood. Have you ever had this test using a home kit?" Individuals responding "Yes" to this question were then asked, "When did you have your last blood stool test using a home kit?" For endoscopic screening, respondents were instructed, "A sigmoidoscopy or colonoscopy is when a tube is inserted in the rectum to view the bowel for signs of cancer and other health problems. Have you ever had this exam?" Individuals responding "Yes" to this question were then asked, "When did you have your last sigmoidoscopy or colonoscopy?" Response categories for both FOBT and endoscopic screening included within the past year, past 2 years, past 5 years, and 5 or more years ago.

We classified an individual as having had colorectal cancer screening if he or she reported undergoing either FOBT within the last year or endoscopic screening within the last 5 years. When applicable, we report subgroup analyses for each of the screening modalities individually. The colon cancer screening rates were based on data from all 50 states and the District of Columbia.

Obesity. Each respondent's BMI was calculated as weight in kilograms divided by height in meters squared. Using World Health Organization BMI categories,[30] we classified individuals as normal weight (BMI 18.5–24.9 kg/m^2), overweight (BMI 25.0–29.9 kg/m^2), obese (BMI 30.0–34.9 kg/m^2, WHO obesity class I), or morbidly obese (BMI ≥35.0 kg/m^2, WHO obesity classes II and III).

Other Covariates. We examined several factors thought to be potential confounders of the relationship between obesity and screening. Sociodemographic factors included age, gender, ethnicity (white, black, Hispanic, or other), education (not a high school graduate, high school graduate, some college, college, or advanced degree), marital status (married, single, widowed, divorced, or separated), income (<$15,000, $15,000–$24,999, $25,000–$34,999, $35,000–$49,999, $50,000–$74,999, ≥$75,000), and census region (Northeast, South, Midwest, or West). Other variables examined as potential confounders included self-reported health status (excellent, very good, good, fair, or poor), smoking status (current, past, or never), time since last checkup (within past year, or over 1 year ago), and lack of insurance coverage for any part of the past year.

Statistical Analyses

We stratified respondents based on BMI and tabulated the characteristics of each group. We then calculated colorectal cancer screening rates for the entire population, and separately for each BMI group and each sociodemographic group. We assessed the association between BMI and CRC screening using multiple logistic regression to control for potential confounders. Because we were unsure whether the relationship between BMI and CRC screening would exhibit a graded or a threshold pattern, we examined the results for trends and then separately compared each overweight/obese group to the corresponding group with normal BMI.

To obtain U.S. population estimates, we used BRFSS sampling weights that account for the demographic profile and nonresponse rates in each state. We calculated adjusted CRC screening rates for each BMI group by direct standardization to the demographic characteristics of the study population using the coefficients from our multivariable model.[31,32] We calculated the difference in adjusted rates by subtracting the adjusted rate for the group with a normal BMI from the adjusted rates for each of the other BMI groups. To examine our hypothesis that the relationship between morbid obesity and CRC screening would be similar among men and women, we stratified by gender and compared CRC screening rates among men and women separately. We reran analyses after redefining CRC screening to include those who reported ever receiving a sigmoidoscopy or colonoscopy to see whether our results were sensitive to this reclassification.

Analyses were performed using SAS-callable SUDAAN, version 8.0 (Research Triangle Institute, Research Triangle Park, NC) to account for the complex sampling design in calculating variances.[33,34] Missing data for each variable ranged from 0.2% to 1.1% with the exception of income, which was missing in 17% of respondents. First, we excluded individuals from the multivariable analyses if they lacked any of the required covariates (including income). Then, we repeated the analyses including those missing income using a dummy variable in the model. Because the relationship between BMI and CRC screening did not differ significantly between the two analyses, results are reported for the latter analysis.

RESULTS

Among 52,886 respondents representing 64,563,332 U.S. adults age 51 to 80, 6.4% were morbidly obese, 15.9% were obese, and 41.1% were overweight. A higher BMI was associated with younger age, black race, lower educational attainment, lower income, and lower likelihood of being married (Table 1). Those with a higher BMI were more likely to have had a checkup in the past year, more likely to be uninsured for part or all of the past year, and more likely to report their health status as fair or poor.

Colorectal cancer screening rates were low overall, with 43.8% receiving either FOBT or endoscopic screening within recommended screening intervals (data not shown). Approximately 21% of respondents reported an FOBT in the past year, while 34% reported endoscopic screening for CRC within the past 5 years. Rates of colorectal cancer screening varied by BMI (Table 2). The rate of screening for morbidly obese respondents was 39.5%, significantly lower than the rate for obese (45.0%), overweight (44.3%), or normal weight (43.5%) groups.

Many of the population characteristics we studied were significantly associated with the likelihood of undergoing colorectal cancer screening (Table 3). Those who were less than 65 years of age, female, Hispanic, not high school graduates, widowed, divorced, or separated, had low incomes, or were uninsured for part or all of the past year were significantly less likely than others to receive CRC screening. Current smokers and those respondents whose last checkups were over 1 year ago were also less likely to be screened than their counterparts. Respondents who reported fair or poor health status were more likely to be

Table 1. Characteristics of Study Sample*

Characteristic	Normal Weight BMI 18.5 to 24.9	Overweight BMI 25.0 to 29.9	Obese BMI 30.0 to 34.9	Morbidly Obese BMI ≥35
Number of respondents	19,826	21,285	8,315	3,460
Estimated population size	23,592,877	26,544,848	10,269,497	4,156,110
		%		
Age groups, years				
50–64	53.5	58.4	59.6	67.7
65–74	32.1	30.6	30.5	24.7
≥75	14.5	11.0	9.9	7.6
Female	61.8	44.7	50.6	62.0
Ethnicity				
White, non-Hispanic	83.3	80.2	78.0	75.4
Black, non-Hispanic	5.9	8.5	9.9	13.9
Hispanic	6.7	8.7	10.0	8.3
Other	4.2	2.7	2.2	2.4
Not a high school graduate	14.3	16.5	21.6	24.2
Widowed, divorced, separated, or single	33.5	30.3	31.9	39.9
Annual household income, $				
<15,000	11.0	11.2	15.0	17.9
15,000–50,000	44.2	45.7	47.2	47.6
≥50,000	25.5	26.1	22.3	18.6
Missing	19.3	17.1	15.5	16.0
Region				
Northeast	20.4	20.2	20.0	17.8
South	37.4	37.3	37.6	38.0
Midwest	20.1	22.0	22.7	26.1
West	22.2	20.5	19.8	18.1
Uninsured for part (or whole) year	8.3	8.4	10.1	12.7
Fair or poor self-reported health status	18.9	21.0	29.3	40.3
Last checkup within past year	79.3	80.2	82.7	83.5
Current smoker	20.2	15.9	12.2	12.6

* *All comparisons,* $P < .001$.

Table 2. Unadjusted Rates of Colorectal Cancer Screening by Weight Status

	Normal Weight BMI 18.5 to 24.9	Overweight BMI 25.0 to 29.9	Obese BMI 30.0 to 34.9	Morbidly Obese BMI ≥35
Estimated Population Size	23,592,877	26,544,848	10,269,497	4,156,110
	%			
FOBT or endoscopic screening	43.5	44.3	45.0	39.5†
FOBT	21.5	20.4	20.4	18.3†
Endoscopic screening	33.1	34.4	35.2	30.3*

* P < .05 for comparison to normal weight.
† P < .01 for comparison to normal weight.
FOBT, fecal occult blood test (FOBT) within the past year; endoscopic screening, sigmoidoscopy or colonoscopy within the past 5 years.

screened than others. Residents of the Northeast were significantly more likely and residents of the South were significantly less likely to be screened than others (data not shown).

After adjustment for confounders, rates of colorectal cancer screening were still lower among the morbidly obese group (40.5%) compared to the normal weight group (43.8%). The difference in screening rates was entirely attributable to differences in BMI among women. Morbidly obese women (Table 4) were significantly less likely than women with a normal BMI to receive colorectal cancer screening, with rates of 37.1% and 42.7%, respectively (adjusted rate difference –5.6%; 95% CI, –2.6 to –8.5). There were no obesity-related disparities in screening rates for men. CRC screening rates among obese and overweight respondents did not differ significantly from screening rates among the normal weight group even after gender stratification. These findings were unchanged when we redefined screening to include those who had ever received a sigmoidoscopy or colonoscopy.

DISCUSSION

Solid evidence suggests that population screening can substantially reduce the incidence of colorectal cancer and mortality from the disease,[2–8] yet rates of CRC screening continue to be surprisingly low. Obesity, which is associated with a higher incidence of colorectal cancer[11–18] and a higher mortality from the disease,[19,20] could be an important clinical marker of the need for screening. Nevertheless, we found statistically significantly lower rates of colorectal cancer screening among one important group of patients at increased risk—morbidly obese women. Although small, this difference in the screening rate for morbidly obese women compared to others persisted despite adjustment for other potentially important confounders. The lower screening rate was apparent only among morbidly obese women. We found no differences in colorectal cancer screening among overweight or obese women compared to women with a normal BMI. We also did not observe BMI-related differences in colorectal cancer screening among men.

Table 3. Association Between Colorectal Cancer Screening and Covariates Used for Adjustment

Characteristic	Colorectal Cancer Screening* in Each Population		
	With Characteristic	Without Characteristic	Difference (*P* Value)
	%		
Age ≥65 years	52.0	37.7	<.0001
Female	42.7	45.0	.0018
Ethnicity			
White	45.0	38.9	<.0001
Black†	42.5	43.9	.31
Hispanic†	35.2	44.6	<.0001
Other†	39.5	43.9	.09
Not a high school graduate	37.6	45.1	<.0001
Widowed, divorced, separated, or single	40.9	45.2	<.0001
Household income <$15,000	36.3	44.8	<.0001
Perceived health status, fair or poor	45.3	43.4	.0226
Current smoker	33.1	45.9	<.0001
Last checkup over 1 year ago	20.7	59.4	<.0001
Uninsured for part or all of past year	23.3	45.8	<.0001

* *Unadjusted rates of FOBT in past year OR endoscopic screening for CRC in past 5 years with and without listed covariates.*
† *Compared to all other ethnicities.*

Table 4. Adjusted Rates of Colorectal Cancer Screening*

	Normal Weight BMI 18.5–24.9	Morbidly Obese BMI ≥35	Rate Difference† (95% CI)
	%		
Overall			
FOBT or endoscopic screening	43.8	40.5	−3.3 (−5.9 to −0.7)‡
Endoscopic screening	33.8	31.5	−2.3 (−5.0 to 0.6)‡
FOBT	20.7	18.7	−2.0 (−3.8 to −0.1)‡
Women			
FOBT or endoscopic screening	42.7	37.1	−5.6 (−8.5 to −2.6)‡
Endoscopic screening	30.8	25.9	−4.9 (−7.7 to −1.9)‡
FOBT	22.4	18.7	−3.7 (−6.2 to −1.1)‡
Men			
FOBT or endoscopic screening	45.0	45.3	+0.3 (−5.0 to 5.1)
Endoscopic screening	37.2	38.8	+1.6 (−3.1 to 6.4)
FOBT	18.7	19.2	+0.5 (−3.0 to 4.4)

* *Screening rate adjusted for age, ethnicity, income, education, marital status, insurance status, region, self-reported health status, smoking status, and time of last medical visit.*

† *Adjusted rates and rate differences are given as a percentage.*

‡ *Denotes significant differences.*

FOBT, fecal occult blood test (FOBT) within the past year; endoscopic screening, sigmoidoscopy or colonoscopy within the past 5 years; CI, confidence interval.

As noted in other studies,[9,10,35,36] overall colorectal cancer screening rates fall well below national guideline-recommended targets.[37] Ours is the first study to examine the association between BMI and colorectal cancer screening and the only study to examine the impact of BMI on rates of cancer screening among men. Prior research demonstrating that obese women were less likely than non-obese women to receive cancer preventive services[22–24] focused on screening for cancers other than colorectal cancer and did not include men. Prior national studies have shown that women have lower rates of colorectal cancer screening than men,[38] while state-based studies have not found consistent gender-related differences in CRC screening.[36,39] Past studies suggest, however, that women are more likely than men to get FOBT and less likely to receive sigmoidoscopy.[10,36,38] Future studies may help clarify whether the impact of BMI on preventive services is limited to women and whether it extends to the use of other preventive services.

We found a "threshold" relationship between BMI and CRC screening rates, with a significant effect of BMI on screening of morbidly obese women but no effect of BMI on screening rates for women who would be classified as overweight or obese. Other researchers have found a similar threshold effect of BMI on the rate of pelvic examinations. Among women, only those with the highest BMIs are significantly less likely than others to receive pelvic exams.[24] In two other studies, rates of breast and cervical cancer screening were lower for women with higher BMI, but there was not a clear threshold at which lower screening rates were apparent.[22,23]

The causes of lower screening rates among obese individuals remain elusive. However, our finding of gender-related differences in the association between BMI and CRC screening may shed light on some of the factors that contribute to screening disparities. Obesity-related disparities may result from patient factors, physician factors, or their interactions. Patient-related factors may include poorer access to care (perhaps mediated by lower socioeconomic status[40] or ability to pay) or increased reluctance among obese individuals to undergo screening.[24] The obese individuals in this sample were of a lower socioeconomic status and more likely to be uninsured regardless of gender. However, in our study, these factors did not account for the difference in screening rates we observed.

Physician-related barriers to screening may include a perceived increase in the technical difficulty of the procedures, the competing demands of managing other clinical comorbid conditions[41,42] such as hypertension or diabetes, or physician bias against obese patients.[24,43–47] Greater technical difficulty seems less likely to explain our results. Procedures should be equally challenging among morbidly obese men and women, suggesting that the BMI-related differences should be similar for men and women, but we found no BMI-related difference in screening rates among men. Likewise, both men and women who are obese tend to have more competing comorbid conditions,[48] arguing against comorbidity as the cause of BMI-related disparities in screening. Further, sigmoidoscopy may pose more technical difficulty in obese patients but FOBT should not, yet we found lower rates of both procedures among morbidly obese women. The gender and BMI interaction we observed is consistent with prior research suggesting that bias and stigmatization related to obesity may be more severe for women than for men.[40] Patient reluctance to undergo screening and physician reluctance to recommend or encourage screening for morbidly obese women may reinforce one another in contributing to decreased screening in this high-risk population.[24]

Our study has some limitations. Our measures of colon cancer screening and BMI are based on self-report. Prior research has shown a high correlation between self-report and chart audit for FOBT and sigmoidoscopy.[49,50] Weight, however, tends to be increasingly underreported as BMI increases,[51] but systematic underestimation of BMI among the most obese individuals would bias our findings toward the null. Past research, however, suggests a high reliability and validity of self-reported height and weight in the BRFSS.[52] There is a possibility that not all of the respondents in our sample were eligible for CRC screening. Persons with decreased life expectancy or other contraindications to screening might not be identified; however, we would expect these numbers to be small. The BRFSS is a telephone-based survey and may only be generalizable to the 94% of the noninstitutionalized U.S. population with telephones.[53] The BRFSS only asks a single question that combines colonoscopy and sigmoidoscopy and does not include a question about screening with barium enema, making it possible to misclassify as unscreened individuals who had actually received a barium enema or a colonoscopy 5 to 10 years earlier. Our study was not designed to identify all of the mediators of BMI-related disparities. Future studies are needed to understand other barriers to CRC screening and the best practices to increase screening among morbidly obese women.

In summary, our results show that colorectal cancer screening rates are disturbingly and persistently low in the United States. Our results are an important demonstration of an easily measured marker of increased disease risk (BMI) that primary care clinicians should consider in targeting vulnerable populations for screening. Yet, morbidly obese women, who are at increased risk of developing and dying from colorectal cancer, appear less likely to receive screening than others. General efforts to boost CRC screening rates are clearly needed, and our results suggest that special efforts to increase screening of morbidly obese women may be important. Future studies should explore the reasons morbidly obese women are less likely to be screened than others. Such information could be highly useful in designing strategies to increase screening of the general population, while eliminating the disparity identified by our study.

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