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Adherence to Colorectal Cancer Screening in Mammography-Adherent Older Women

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Colorectal cancer (CRC) is the third leading cause of cancer mortality among women. Screening can prevent the development of CRC or diagnose early disease when it can effectively be cured, however existing screening methods are underutilized. In this study, we examined the utility of an updated Health Belief Model to explain CRC screening adherence. The present study included 280 older women seeking routine mammography at a large, urban breast diagnostic facility. Overall, 50% of women were adherent to CRC screening guidelines. Multiple regression indicated that self-efficacy, physician recommendation, perceived benefits of and perceived barriers to screening accounted for 40% of variance in CRC screening adherence. However, there was no evidence for two mediational models with perceived benefits and perceived barriers as the primary mechanisms driving adherence to CRC screening. These findings may inform both future theoretical investigations as well as clinical interventions designed to increase CRC screening behavior.

KEY WORDS: colorectal cancer screening; adherence; Health Belief Model; older women.

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Among women, cancers of the colon and rectum (colorectal cancer, CRC) are the third leading cause of cancer mortality (American Cancer Society [ACS], 2003). Women are at similar lifetime risk of being diagnosed with CRC and have comparable mortality rates from this illness as men (ACS, 2003). In 2003, it is estimated that 74,700 women will be diagnosed with CRC and 28,800 women will die of it (ACS, 2003). Research has shown that a diagnosis of earlier stage malignancy decreases cancer-related mortality rates (Ries *et al.*, 2000). Indeed, among women diagnosed with CRC, the 5-year survival rate is 90% if CRC is diagnosed with a localized stage. Unfortunately, only 37% of colorectal cancers are currently found at a local stage (Ries *et al.*, 2002).

At present, there are several colorectal screening procedures that the American Cancer Society (ACS) recommends for average-risk adults, starting at the age of 50, including yearly fecal occult blood testing (FOBT), flexible sigmoidoscopy every 5 years, yearly FOBT plus flexible sigmoidoscopy every 5 years, double-contrast barium enema every 5 years, or colonoscopy every 10 years (ACS, 2003). The literature establishing the efficacy of various CRC screenings has found reductions in mortality of 15–33% in randomized controlled trials of FOBT (Hardcastle *et al.*, 1996; Kronborg *et al.*, 1996; Mandel *et al.*, 1993) and reductions in mortality of 50–59% with flexible sigmoidoscopy (Newcomb *et al.*, 1992; Selby *et al.*, 1992; Thiis-Evensen *et al.*, 1999). Adding FOBT to sigmoidoscopic screening has been associated with decreased CRC mortality rates (Winawer *et al.*, 1993), however there are no randomized trials examining the combination of these two screening tests. Double-contrast barium enemas have been found to detect many adenomatous polyps and early stage CRC, but have not been related to CRC mortality, per se (Fork, 1981; Hixson *et al.*, 1991; Steine *et al.*, 1993; Winawer *et al.*, 1997). To date, no efficacy trials exist examining whether CRC screening by colonoscopy reduces mortality rates. Indirect evidence, however, suggests that using colonoscopy to detect and remove adenomatous polyps reduces CRC incidence by 76–90% (Winawer *et al.*, 1993). These research findings support the use of FOBT, flexible sigmoidoscopy, and colonoscopy for CRC screening, and it is likely that reductions in CRC mortality will be observed with widespread adoption of these surveillance recommendations.

Several studies have documented that women are less likely to undergo CRC screening than men (Brenes and Paskett, 2000; Brown *et al.*, 1990), in part because CRC has been traditionally viewed as a male disease (Donovan and Syngal, 1998). Among women age 50 and older, only 18–24% report having had a FOBT within the past 2 years and 33% report ever having had a sigmoidoscopy or colonoscopy examination (Center for Disease Control and Prevention [CDC], 1999, 2001; National Health Interview Survey [NHIS], 1998). One major criticism of the literature regarding

CRC screening adherence is that participants have been asked whether they have undergone a specific CRC test (e.g., have you ever had a FOBT?, have you had a flexible sigmoidoscopy in the past 5 years?). However, the problem with this measurement approach is that it does not distinguish between those individuals who have undergone CRC testing for screening purposes or for diagnostic purposes (Baier *et al.*, 2000). Nevertheless, these reported rates still lag dramatically behind mammography screening rates, which are currently 79% among women over the age of 50 in the United States (Behavioral Risk Factor Surveillance System [BRFSS], 2000).

Brenes and Paskett (2000) found that women who were adherent to mammography were more likely to be adherent to CRC screening, specifically flexible sigmoidoscopy. This observation suggests the value of targeted interventions that link multiple cancer screening behaviors and address common barriers to screening so as to increase overall adherence rates (Rimer, 2002). Although there remains work to be done to increase cancer screening rates, particularly in underserved populations, a large proportion of American women already receive regular cancer screening in the form of Papanicolaou (Pap) smears and mammography. Therefore, encouraging these women to adopt screening for CRC would have a relatively wide reach and may result in substantial public health benefit. To increase the rates of CRC screening among women, it is important to identify the correlates of participation in CRC screening so as to guide the development and delivery of empirically-based interventions.

The Health Belief Model (HBM; Janz and Becker, 1984) has been widely used to explain cancer screening adherence, but has received limited attention with regard to CRC screening. The HBM states that preventive health behavior depends mostly on the desire to avoid illness and the belief that a specific health action will prevent illness. Specifically, the original HBM consisted of four independent predictors: perceived susceptibility of developing illness, perceived severity of the illness, as well as the perceived benefits of and barriers to performing the recommended preventive health action. A person's tendency to take preventive health action is hypothesized to be increased by high perceived susceptibility, high severity, high benefits, and low perceived costs or barriers. Some stimulus is thought necessary to trigger the decision-making process, and this "cue to action" might be internal (e.g., symptoms) or external (e.g., physician recommendation) (Janz and Becker, 1984). In 1988, Rosenstock and colleagues suggested that the HBM would be strengthened by the addition of self-efficacy; a belief in one's own competence in implementing a recommended specific behavior.

One major criticism of the HBM is that it has not included hypotheses about the relations among the health beliefs or about the relative importance of the four beliefs in influencing decisions (Ronis, 1992). Another criticism

is that many studies of CRC screening using the HBM constructs have not included all of the HBM variables when attempting to explain CRC screening adherence (e.g., Blalock *et al.*, 1990; Burack and Liang, 1987; Myers *et al.*, 1990; Sandler *et al.*, 1989).

Research investigating psychosocial correlates of CRC screening adherence has generally found that high perceived benefits of screening and low perceived barriers to screening are associated with CRC screening adherence (Halper *et al.*, 1980; Hoogewerf *et al.*, 1990; James *et al.*, 2002; Kelly and Shank, 1992; Lewis and Jensen, 1996; Manne, 2002; Manne *et al.*, 2002; Myers *et al.*, 1994; Wardle *et al.*, 2000). Perceived barriers have also been found negatively related to mammography adherence (Aiken, 1994b). Self-efficacy (DeVellis *et al.*, 1990; Hoogewerf *et al.*, 1990; Myers *et al.*, 1994, 1998) and physician recommendation (Brenes and Paskett, 2000; Brown *et al.*, 1990; Friedman *et al.*, 1999; Lewis and Jensen, 1996; Mandelson *et al.*, 2000; Manne, 2002; Manne *et al.*, 2002; Myers *et al.*, 1990) have also been reported as positively related to CRC screening adherence. Other significant psychosocial correlates of CRC screening adherence are perceived behavioral control, which concerns beliefs about the relative ease or difficulty of performing a behavior (DeVellis *et al.*, 1990), and belief in the salience and coherence of screening (Myers *et al.*, 1994, 1998). A significant relationship between perceived susceptibility and severity with CRC screening adherence has not been consistently documented in the literature (Blalock *et al.*, 1990; Burack and Liang 1987; Halper *et al.*, 1980; Lipkus *et al.*, 2000; Macrae *et al.*, 1982; 1984; Price, 1993; Weller *et al.*, 1995). These findings have guided the development of provider and community-based interventions to promote CRC screening.

To improve the predictive validity of theoretical models of screening adherence, an updated HBM has been developed (Aiken *et al.*, 1994a; Ronis, 1992) that has an advantage over the original model in that it examines processes, or mediators, among the HBM variables rather than only independent predictors. This updated model combines the original HBM with the Theory of Subjective Expected Utility (Luce and Raiffa, 1957) in order to derive hypotheses about the relations among health beliefs and preventive behaviors. The advantage of this new model is that it provides information about the process of change and adherence, and therefore, may better inform and advance future interventions designed to increase screening behaviors. The model posits that changes in the risk–benefit ratio represent the primary mechanism that leads to screening behavior. Specifically, the updated HBM states that perceived susceptibility and perceived severity are related to increased perceived benefits and decreased perceived barriers of the preventive health behavior (e.g., CRC screening) that ultimately are related to the health behavior directly.

There is evidence accumulating for these hypothesized mediational mechanisms, and evidence for mediation is stronger for benefits than barriers (Aiken, 1994b). A recent study regarding intention to undergo colonoscopy among siblings of patients diagnosed with CRC reported that perceived benefits partially mediated the relationships between sibling closeness, physician support, and family support with the intention to screen, indicating the importance of perceiving benefits of screening. In addition, perceived barriers mediated the relationships between sibling closeness and perceived severity with intention to undergo CRC screening (Manne, 2002). These results indicate the potential processes by which important psychosocial variables function to impact the risk–benefit ratio of screening, and ultimately screening itself. This evidence suggests that the HBM covariates are related to perceived benefits of and barriers to CRC screening, which in turn, are related to adherence to CRC screening. Understanding the processes underlying health behavior change will assist in tailoring interventions designed to increase screening adherence. However, many of the prior studies of the updated HBM have been limited in their investigation of potential covariates that may influence perceived benefits and barriers, for the most part focusing only on perceived susceptibility and severity.

The present study sought to examine CRC screening in older women adherent to mammography and to advance the theoretical understanding of the psychological process by which individuals are adherent to CRC screening. By utilizing women receiving routine mammography, it is possible to examine CRC screening attitudes and behaviors among a group of women who are already attuned to health promotion and cancer prevention, as they are currently adherent to breast cancer screening recommendations. Guided by the updated HBM, we examined CRC screening adherence in this sample of mammography-adherent older women. We were specifically interested in answering the following questions:

1. Is the updated HBM useful in explaining adherence to CRC screening? Specifically, are perceived susceptibility to CRC, perceived severity of CRC, self-efficacy for CRC screening, physician recommendation for CRC screening, and perceived benefits of and barriers to CRC screening significantly related to older women's CRC screening adherence?
2. Are perceived susceptibility, severity, self-efficacy, and physician recommendation significantly related to perceived benefits of and barriers to CRC screening among older women?
3. As proposed by Aiken *et al.* (1994a) and Ronis (1992), are higher perceived benefits and lower perceived barriers the mechanisms by which perceived susceptibility, severity, self-efficacy, and physician

recommendation related to CRC screening adherence for older women?

METHOD

Participants

Participants were 280 women who were part of a larger study (total N = 435)[7] assessing attitudes and adherence to multiple cancer screenings among older women seeking routine mammography. Participants were required to be at least 50 years old and have no personal history of CRC.

The typical participant in the study was 62 years old (SD = 7.36), married or living with a partner (51.6%), Caucasian (76.1%), had health insurance (98.9%), and had at least a college degree (56.6%). Approximately half of the participants were employed (48.7%), and 49.2% reported a family income between $30,000 and $69,999 (see Table I for additional descriptive information regarding study participants).

Procedure and Measures

Women, age 50 and over, seeking routine mammography at a large, urban breast diagnostic facility from December 1998 to June 2000 were approached by a research interviewer and invited to participate in a health-belief survey about their knowledge, attitudes, and adherence to multiple cancer screening and health-promoting behaviors. Women who provided written informed consent were given an assessment battery to return in a preaddressed, stamped envelope. If the health-belief survey was not returned in 2 weeks, up to two weekly follow-up phone calls were made to encourage survey completion. The overall response rate was 82.9%.

The questionnaires contained a number of measures about a variety of health behaviors and beliefs, not all of which are relevant to this article regarding CRC screening. The study questionnaires included measurement of health beliefs about CRC, history of CRC screening, and future intention to undergo CRC screening. These measures are described below.

[7]The present study sample size is smaller than the total sample size because all participants were not asked about their personal colorectal cancer history. We wanted to eliminate those individuals who had been diagnosed with colorectal cancer in the past and were being screened for the purposes of medical follow-up, rather than for preventive purposes. Therefore, only a subset of the total number of participants could be utilized.

Table I. Frequencies and Percentages of Demographic and Covariate Variables

	N	Percentage	*M*	SD	Range
Age			62.07	7.36	50–75
Ethnicity					
African American	44	15.8			
Caucasian	213	76.1			
Latino/Hispanic	11	3.9			
Asian	6	2.1			
Other	6	2.1			
Marital status					
Single	57	20.6			
Married/living with partner	143	51.6			
Divorced/separated	47	17.0			
Widowed	30	10.8			
Highest education level attained					
Junior high school	5	1.8			
High school graduate/GED	49	17.5			
Partial college vocational training	54	19.4			
Standard college or university graduate	50	17.9			
Graduate degree or professional training	121	43.4			
Family income					
Less than $10,000	2	0.8			
$10,000–$29,999	34	13.5			
$30,000–$49,999	67	26.6			
$50,000–$69,999	57	22.6			
$70,000–$89,999	34	13.5			
More than $90,000	58	23.0			
Health insurance coverage					
No	3	1.1			
Yes	275	98.9			
Perceived severity of colorectal cancer			13.58	2.02	3–15
Perceived susceptibility to colorectal cancer			2.99	0.75	1–5
Self-efficacy					
FOBT			3.82	1.35	1–5
Flexible sigmoidoscopy			3.42	1.42	1–5
Colonoscopy			3.54	1.46	1–5
Benefits of colorectal cancer screening			50.54	9.83	20–64
Barriers to colorectal cancer screening			49.27	9.67	33–79

Adherence

Adherence to CRC screening was measured in two ways. We asked participants about their participation in specific CRC screening methods (FOBT within the past year, flexible sigmoidoscopy in the past 5 years, colonoscopy in the past 10 years). We also asked participants to choose one of six statements regarding their CRC screening adherence. These descriptions of the stages of adherence to CRC screening (see Table II) were adapted from the stages of readiness to change in the Transtheoretical Model (TTM;

Table II. Adherence to Colorectal Cancer Screening

Stages	N	Percentage
Maintenance		
I routinely undergo colon cancer screening and plan to continue doing so in the future	135	50.0
Contemplation II		
I have never had colon cancer screening but I intend to have it in the coming year	29	10.8
Contemplation I		
I have never had colon cancer screening but I am thinking about having it in the coming year	53	19.6
Relapse		
I have had colon cancer screening in the past but I do not intend to have it in the future	12	4.4
Precontemplation		
I have never had colon cancer screening and I do not intend to have it in the coming year	8	3.0
Unaware		
I have never thought about colon cancer screening for myself	33	12.2

DiClemente and Prochaska, 1982) and prior studies applying this classification schema to mammography screening intention (Rakowski *et al.*, 1993, 1996) and colorectal screening intention (Manne *et al.*, 2002; Myers *et al.*, 1994, 1998). Using this assessment method, participants were considered currently adherent if they endorsed that they "routinely undergo colon cancer screening and plan to continue doing so in the future."

There are strengths and weaknesses to each CRC screening assessment approach. Assessing CRC screening behaviors separately (i.e., asking participants whether they had undergone a specific test within a specific amount of time) can be problematic as some participants likely underwent the specified procedures for diagnostic reasons. Therefore, some individuals would be misclassified as adherent when in fact they are not adherent for routine screening purposes. However assessing CRC adherence with the stages of adherence statements, may misclassify some individuals as nonadherent, when in fact they are adherent, because of a lack of awareness of the specific medical tests that constitute CRC screening recommendations.

We decided to follow a previously used strategy to measure CRC screening adherence and obtained self-reported past screening behaviors and future intentions to adhere to CRC screening guidelines (see Myers *et al.*, 1994, 1998). Therefore, adherence to CRC screening was measured by having participants choose one of the six descriptions of the stages of adherence that best matched their past screening behavior and future intentions.

We examined the concordance between each approach to assessing CRC screening adherence and found that a majority of individuals who endorsed having FOBT in the past year, flexible sigmoidoscopy in the past 5 years and/or colonoscopy in the past 10 years were also categorized as adherent to CRC screening by the TTM's stages method (see Table III). Given the high agreement between the different approaches to measuring CRC screening adherence, we felt that the most conservative approach was to use the stages of adherence method in order to minimize the number of false positive CRC screeners. We felt that by asking about routine screening adherence, we would minimize the number of individuals considered adherent, who were tested solely for diagnostic reasons.[8]

Family History of Colorectal Cancer

Family history of colorectal cancer was asked with one item, "Have your parents, siblings or children ever been diagnosed with colon cancer?"

Physician Recommendation

Participants were asked whether they had received any *physician recommendations* for colorectal cancer screening. Specifically, participants were asked to report whether their doctor or health care provider had ever recommended a fecal occult blood test (FOBT), flexible sigmoidoscopy and/or colonoscopy for CRC screening.

[8]Additionally, we examined the concordance between those participants who endorsed the maintenance stage of adherence and those who reported either undergoing FOBT within the past year, flexible sigmoidoscopy within the past 5 years, or colonoscopy within the past 10 years. We found that among participants who endorsed undergoing at least one CRC screening, 70.2% reported that they were routinely adherent to CRC screening and planned to screen in the future (maintenance stage) and an additional 6.1% reported that they had undergone screening in the past, however did not plan to continue in the future (relapse stage). Among the remaining participants, it was hypothesized that they may have undergone CRC testing for diagnostic purposes, and not for preventive screening. We then examined all of the participants in the precontemplation, contemplations I and II, and unaware stages and found that only three participants had undergone CRC testing (i.e., two participants endorsed undergoing colonoscopy within the past 10 years and one participant reported undergoing flexible sigmoscopy within the past 5 years) within the recommended time frame to be considered adherent. However, although these three participants were technically adherent to CRC screening, they were not aware of their adherence, as they did not endorse being in the maintenance stage. We felt that given this level of concordance and the small number of participants misreporting their adherence, it was acceptable for us to rely on the stages of adherence as our adherence outcome measure. It is the most conservative approach as it likely does not confound testing for diagnostic purposes with preventive screening, a mistake that others have drawn attention to recently in the literature (Baier *et al.*, 2000).

Table III. Multiple Measures of CRC Adherence

	N (%)		
	Had FOBT (within the past year)	Had flexible sigmoidoscopy (within the past 5 years)	Had colonoscopy (within the past 10 years)
Stages of adherence to CRC screening			
Maintenance	68 (65.4%)	54 (81.8%)	99 (84.7%)
Contemplation II (intend to have screening)	10 (9.6%)	1 (1.5%)	3 (2.6%)
Contemplation I (thinking about screening)	14 (13.5%)	6 (9.1%)	3 (2.6%)
Precontemplation	2 (1.9%)	1 (1.5%)	0 (0%)
Relapse	4 (3.8%)	3 (4.6%)	7 (6.0%)
Unaware	6 (5.8%)	1 (1.5%)	5 (4.3%)

Health Beliefs and Attitudes

Participants were asked to rate their *perceived susceptibility* to CRC on a 5-point scale. Perceived susceptibility was measured with one item, "Compared to other women my age, my chances of having CRC in the future are . . ." (*much less than other women my age—much more than other women my age*). This item was based on previous research on susceptibility to health problems (Weinstein, 1980, 1987).

Perceived severity of CRC was measured using three items, "Having colorectal cancer seriously disrupts health and comfort," "Colorectal cancer greatly influences a person emotionally," and "The health consequences of developing colorectal cancer are very severe" (Aiken *et al.*, 1994a, b). Participants answered each on a 5-point scale (*strongly disagree* to *strongly agree*). Responses to the three items were averaged to form an overall perceived severity score for each participant (Cronbach's $\alpha = 0.76$).

Participants' *self-efficacy* about undergoing CRC screening was measured by the following three items, "How confident are you that you can go for fecal occult blood testing?," "How confident are you that you can go for flexible sigmoidoscopy?," and "How confident are you that you can go for colonoscopy?" Participants answered on a 5-point scale (*not at all confident* to *extremely confident*) (Cronbach's $\alpha = 0.80$).

Participants' *perceived benefits* of CRC screening and *perceived barriers* to undergoing CRC screening were assessed with a 27-item questionnaire. See Table IV for questionnaire items. The questionnaire utilized was based on prior research examining decisional balance of mammography (Rakowski *et al.*, 1993), which assesses benefits (pros) and barriers (cons) to screening. In addition, a gastroenterologist examined and commented on the relevance of

Table IV. Perceived Benefits and Barriers Items for Colorectal Cancer Screening

Benefits
I would feel better about myself if I had colorectal screening
I am confident that I could have colorectal screening on a regular schedule
Having regular colorectal screening would give me a feeling of control over my health
Colorectal screenings are now very routine tests
My family would benefit if I had colorectal screenings
Colorectal screening could find growths that are not yet cancer but might develop into cancer
Colorectal screening is a part of good overall health care
Having regular colorectal screening would give me peace of mind about my health
Colorectal cancer screening is safe
I would be more likely to have colorectal screening if my doctor told me how important it was
Colorectal screening is a useful procedure for people my age
Colorectal screening would help me to live a long life
Barriers
If my doctor didn't mention colorectal screening, I probably would not need it
Colorectal screening has a high risk of leading to unnecessary surgery
If my doctor gave me a thorough examination, then I would not need any special colorectal screening
I would probably not go for colorectal screening unless I had a specific symptom
Once you have had a couple of colorectal screenings in a row that show no problems, you don't need any more
I would probably not have colorectal screening if it involved enemas or laxatives to clear out my colon
Having colorectal screening could be very embarrassing
If colorectal screening found something, whatever the problem was, it would be too far along to do something about it
It would be inconvenient to have colorectal screening at this time
If there were any chance that colorectal screening is not safe, I would not want to have it
The risk of harm from colorectal screening is really quite high
If I maintained a healthy lifestyle, I would lower my risk of getting colorectal cancer and probably would not need to have colorectal screenings
I cannot afford to have colorectal screening tests
I would probably not have colorectal screening if a family member or friend said that it was painful
Colorectal screening would interfere too much with other things I have to do

the selected items. Participants were asked how much they agreed with each statement on a 5-point scale (*strongly disagree* to *strongly agree*). Summary scores for both perceived benefits (Cronbach's $\alpha = 0.86$) as well as perceived barriers (Cronbach's $\alpha = 0.84$) were calculated for each participant.

RESULTS

Descriptive Information

The majority of participants did not have a personal history of breast, skin, or cervical cancer (98.8%) or a family (a first-degree relative) history

of breast, skin, or cervical cancer (90.4%). Thirty-one (11.1%) participants reported that they had a first-degree relative who had been diagnosed with CRC. Thirty-eight percent of participants who had a current spouse or partner reported that their spouse or partner had undergone CRC screening. A majority of participants (81.8%) reported that their physician had recommended at least one of the three CRC tests (i.e., FOBT, flexible sigmoidoscopy, or colonoscopy). Sixty-four percent of participants reported that their physician had recommended FOBT, 37.9% had been recommended to undergo a flexible sigmoidoscopy, and 54.3% had been recommended for a colonoscopy. Sixty-eight percent of participants reported that they had ever undergone FOBT, 42% had flexible sigmoidoscopy and almost 50% had undergone at least one colonoscopy. See Table I for additional descriptive information.

Current Adherence

Half of the participants (50%) reported current adherence to CRC screening recommendations, as indicated by their endorsement of the statement that they routinely undergo CRC screening and plan to continue doing so in the future. Therefore, half of the participants (50%) were currently nonadherent with recommended CRC screening. See Table II for the full distribution of the stages of adherence to CRC screening.

Correlates of Colorectal Cancer Screening Adherence

To determine the relationship between adherence to CRC screening and the hypothesized covariates, several variables had to be recoded. Questions about self-efficacy and physician recommendation were asked separately for each CRC screening procedure (i.e., FOBT, flexible sigmoidoscopy, and colonoscopy), however we were interested in the covariates of CRC screening adherence, regardless of the specific screening procedure. We recoded self-efficacy into high versus low efficacy, which we felt was an acceptable procedure given the bimodal distribution of the variable. Participants were considered to have high self-efficacy if they responded that they were very or extremely confident to go for FOBT, flexible sigmoidoscopy or colonoscopy. Nearly three quarters (74.1%) of participants were considered to have high self-efficacy for CRC screening. Participants were considered to have received a physician recommendation if their physician had recommended any of the three CRC screening procedures (81.8%).

Table V. Univariate Correlations of Adherence With Covariates

	Adherence to colorectal cancer screening	
	Correlations	*p*
Sociodemographic variables		
Age	0.010	0.866
Ethnicity	−0.024	0.691
Marital status	0.028	0.645
Education	0.043	0.481
Health insurance	0.023	0.704
Perceived severity of colorectal cancer	0.200	0.001
Perceived susceptibility to colorectal cancer	0.108	0.078
Physician recommendation	0.470	<0.001
Self-efficacy	0.423	<0.001
Benefits of colorectal cancer screening (pros)	0.486	<0.001
Barriers to colorectal cancer screening (cons)	−0.519	<0.001
Decisional balance (pros–cons)	0.554	<0.001
Personal history of colorectal cancer screening		
Ever had rectal exam	0.162	0.008
Ever had FOBT	0.201	0.001
Ever had flex sigmoidoscopy	0.348	<0.001
Ever had colonoscopy	0.443	<0.001
Family history of colorectal cancer	−0.133	0.029
Partner screened for colorectal cancer	0.021	0.735

Utilizing these recoded variables, bivariate correlations between CRC screening adherence and each covariate were calculated and are presented in Table V. The significant correlations ranged from −0.133 to 0.554. The strongest relationship was between CRC screening adherence and perceived barriers to screening. Unrelated to adherence were the sociodemographic variables, perceived susceptibility, and having a partner who had been screened for CRC.

Identifying Mediators of Colorectal Cancer Screening Adherence

To test each of the proposed mediational models, three regression equations were conducted as recommended by Baron and Kenny (1986). First, we regressed the dependent variable on the independent variable; second, we regressed the mediator on the independent variable; and third, we regressed the dependent variable on both the independent variable and on the mediator. In general, a given variable is said to function as a mediator to the extent that it accounts for the relationship between the dependent and independent variables. To function as a mediator, the following

Table VI. Mediational Models Predicting Adherence to CRC Screening With Perceived Benefits as a Mediator ($N = 280$)

	Variable	ß	*t*	*p*	Part *r*	*R*	$R^2\Delta$	$F\Delta$
Step 1	Perceived severity	0.209	3.35	<0.001		0.209	0.044	11.08*
Step 2	Perceived severity	0.129	2.31	0.022	0.127			
	Perceived benefits	0.463	8.29	<0.001	0.456	0.502	0.208	68.70*
Step 1	Self-efficacy	0.428	7.29	<0.001		0.428	0.183	53.23*
Step 2	Self-efficacy	0.313	5.52	<0.001	0.298			
	Perceived benefits	0.377	6.66	<0.001	0.359	0.559	0.129	44.35*
Step 1	Physician recommendation	0.453	8.02	<0.001		0.453	0.205	64.25*
Step 2	Physician recommendation	0.341	6.35	<0.001	0.327			
	Perceived benefits	0.389	7.26	<0.001	0.373	0.587	0.139	52.64*

*$p < 0.01$.

conditions must be met: (a) there must be a significant relationship between the independent variable and the mediator, (b) there must be a significant relationship between the mediator and the dependent variable, and (c) when the two previous paths are controlled, a previously significant relationship between the independent and dependent variable is no longer significant. Results of the stepwise regression analyses are presented in Tables VI and VII. The first set of mediational models proposed that perceived benefits would mediate the relationship between each of the covariates (perceived susceptibility, severity, self-efficacy, physician recommendation) and the outcome variable (adherence to CRC screening). The second set of

Table VII. Mediational Models Predicting Adherence to CRC Screening With Perceived Barriers as a Mediator ($N = 280$)

	Variable	ß	*t*	*p*	Part *r*	*R*	$R^2\Delta$	$F\Delta$
Step 1	Perceived severity	0.191	3.08	0.002		0.191	0.037	9.51*
Step 2	Perceived severity	0.168	3.16	0.002	0.168			
	Perceived benefits	−0.509	−9.56	<0.001	−0.508	0.543	0.258	91.29*
Step 1	Self-efficacy	0.429	7.35	<0.001		0.429	0.184	54.00*
Step 2	Self-efficacy	0.272	4.82	<0.001	0.253			
	Perceived benefits	−0.427	−7.55	<0.001	−0.397	0.585	0.158	56.99*
Step 1	Physician recommendation	0.458	8.17	<0.001		0.458	0.210	66.73*
Step 2	Physician recommendation	0.330	6.24	<0.001	0.314			
	Perceived benefits	−0.418	−7.92	<0.001	−0.398	0.607	0.159	62.78*

*$p < 0.01$.

mediational models proposed that perceived barriers would mediate the relationship between each of the covariates stated above and CRC screening adherence.

Perceived susceptibility was not significantly related to adherence to CRC screening ($\beta = 0.243$, $R^2 = 0.012$, $p = 0.078$), therefore mediation could not be tested (Baron and Kenny, 1986). However, perceived severity, self-efficacy, and physician recommendation were all found to be significantly related to adherence to CRC screening. The two proposed mediators, perceived benefits and perceived barriers, were also found to be significantly related to CRC screening adherence, therefore mediation could be tested. For the first proposed mediator, perceived benefits, mediation was not supported (see Table VI) for any of the covariates because the relationship between the covariates and the outcome variable remained significant even after the mediator was added to the model. For the second proposed mediator, perceived barriers, mediation was also not supported (see Table VII) for any of the proposed covariates.

Finally, because our two proposed mediational models were not supported, we wanted to calculate the proportion of variance our independent covariates would account for in our outcome measure. A multiple regression analysis was performed, utilizing the variables (the proposed covariates and mediators) that were significantly related to CRC screening adherence in the univariate analyses. The final regression analysis included perceived severity, self-efficacy, physician recommendation, family history of CRC, perceived benefits of and perceived barriers to CRC screening as covariates. Findings indicated that approximately 40% of the variance in CRC screening adherence was explained by self-efficacy of CRC screening, physician recommendation to CRC screening, perceived benefits of CRC screening, and perceived barriers to CRC screening ($R^2 = 0.407$, $F = 25.36$, $p < 0.001$) (See Table VIII).

Table VIII. Multiple Regression Analyses—Predicting CRC Screening Adherence

Variable	ß	*t*	*p*	Part *r*
Perceived barriers	−0.271	−4.02	<0.001	−0.208
Physician recommendation	0.204	3.47	0.001	0.179
Perceived benefits	0.193	2.90	0.004	0.150
Self-efficacy	0.168	2.75	0.006	0.142
Family history of CRC	−0.070	−1.36	0.177	−0.070
Perceived severity	0.071	1.34	0.182	0.069

Note. Model summary: $R^2 = 0.407$, $F(6, 222) = 25.36$, $p < 0.001$.

DISCUSSION

In this study, we examined covariates of CRC screening adherence among women, age 50 and older, who were currently adherent to routine mammography recommendations. To do this we utilized an updated and expanded HBM as a theoretical framework. Approximately 50% of our participants were adherent to CRC screening, as indicated by their endorsement that they routinely undergo CRC screening and plan to continue doing so in the future. Our participants' CRC screening adherence rates are lower than breast cancer screening adherence rates (i.e., mammography) among women over 50 years old that are currently estimated at 79% (BRFSS, 2000). However, our participants' CRC screening adherence rates are higher than the adherence rates reported in previous studies of CRC screening. Specifically, among women age 50 and older, there is an 18–24% reported rate of FOBT within the past 2 years and a 33% rate of ever having had a sigmoidoscopy or colonoscopy examination (CDC, 1999, 2001; NHIS, 1998).

A number of factors may explain why our participants had a higher CRC screening rate than a nationally-based sample of women. It may be related to their higher socioeconomic status, as compared to the U.S. general population. Most participants reported that they were highly educated and earned a high family income and had adequate health insurance. These socioeconomic indicators have been shown to be positively associated with CRC screening adherence in previous studies (Anderson and May, 1995; Brown *et al.*, 1990; CDC, 1996, 1999, 2001; Polednak, 1990). Our participants' higher CRC screening adherence rate may also be related to the fact that the women were health-conscious, as they were already aware of the preventive health benefits of cancer screening and its large role in reducing mortality, as suggested by their current adherence to mammography. However, the fact that all of our participants were undergoing routine mammography makes this study's 50% CRC screening adherence rate all the more disappointing. Interventions need to be devised to raise CRC screening adherence rates, and mammography screening sites may be an innovative channel for the delivery of health educational interventions to promote additional cancer screenings (Shike and Genao, 2001). Specific examples of interventions to increase CRC adherence include increasing physician recommendations and providing education regarding the benefits of CRC screening. There is a recognized growing need to develop effective and cost-effective strategies to address multiple health risk and preventive behaviors (Campbell *et al.*, 2000).

Several measures from the updated HBM were significantly associated with CRC screening adherence. Specifically, perceived severity, perceived benefits of and barriers to CRC screening, and self-efficacy for screening

were found to have significant independent relationships with CRC screening adherence. Perceived severity of CRC was significantly correlated with CRC screening adherence among our participants, however when included in the multiple regression model with the other covariates, the relationship became nonsignificant. This is consistent with the literature suggesting that perceived severity is not associated with CRC screening (Burack and Laing, 1987; Halper *et al.*, 1980; Manne, 2002). Also similar to the literature regarding perceived severity of CRC, a majority of individuals in our study reported that CRC was fairly severe (over 70% of women strongly agreed with statements that CRC had severe physical and emotional consequences), indicating low variance of perceived severity and therefore restriction of range which may have led to our insignificant findings.

Perceived benefits of and barriers to screening were also found to be significantly and independently related to CRC screening adherence and remained significant covariates when included in the multiple regression model. This is also similar to the literature reporting that high perceived benefits of screening and low perceived barriers to screening, (also known as high pros and low cons of screening from the Transtheoretical Model) (TTM; Prochaska and DiClemente, 1986), are associated with CRC screening adherence (Halper *et al.*, 1980; Hoogewerf *et al.*, 1990; James *et al.*, 2002; Kelly and Shank, 1992; Lewis and Jensen, 1996; Manne *et al.*, 2002; Myers *et al.*, 1994; Wardle *et al.*, 2000). Perceived benefits and barriers have received recent attention as important covariates related to cancer screening behaviors, and new scales have been validated to measure the benefits (pros) and barriers (cons) of CRC screening, which should help standardize the future measurement of these constructs (Manne *et al.*, 2002; Rawl *et al.*, 2001).

Self-efficacy, a more recent addition to the HBM, was significantly, independently related to CRC screening adherence, and remained a significant covariate when included in the multivariate model. Among women in our sample, 74.1% reported feeling very to extremely confident that they could go for FOBT, flexible sigmoidoscopy or colonoscopy. This is consistent with the psychological literature indicating that a person's belief that he or she can implement a health behavior is highly associated with the maintenance of the health-related behavior (Bandura, 1982; O'Leary, 1985, 1992). An example of this finding is the research that indicates that women's self-efficacy about performing breast self-examination (BSE) is associated with higher levels of BSE adherence (Ronis and Kaiser, 1985; Rutledge and Davis, 1988; Stefanek and Wilcox, 1991).

One component from the HBM that was not significantly related to CRC screening adherence was perceived susceptibility to CRC. This is inconsistent with some of the literature that has found a significant positive relationship between perceived susceptibility and CRC screening among

individuals at average risk for CRC (Kelly and Shank, 1992; Macrae *et al.*, 1984; Price, 1993) and those at increased risk for the disease (Blalock *et al.*, 1990; Manne *et al.*, 2002). Perceived susceptibility has been included in most major theories of health actions, including the HBM (Janz and Becker, 1984), and others (Ajzen and Fishbein, 1980; Leventhal and Cameron, 1987; Rogers and Mewborn, 1976; Weinstein, 1988), but for CRC screening the prior findings have been inconclusive (Blalock *et al.*, 1990; Burack and Liang 1987; Halper *et al.*, 1980; Kelly and Shank 1992; Lewis and Jensen, 1996; Lipkus *et al.*, 2000; Macrae *et al.*, 1982; Price, 1993). In a recent investigation examining the utility of the updated HBM to explain CRC screening among high-risk individuals, investigators found that perceived susceptibility was not significantly related to any other covariates and was eventually dropped from the model (Manne, 2002).

Our findings should be interpreted in light of recently raised measurement and design issues regarding perceived susceptibility (Vernon *et al.*, 2001). For example, perceived susceptibility is often measured utilizing multipoint scales anchored by numbers and/or comparisons to other individuals. These measurement strategies can be problematic, as people have difficulty formulating their perceptions of susceptibility into numerical probability (Weinstein, 1999). In addition, perceived susceptibility is often measured in studies that utilize cross-sectional designs. This may be problematic because of the inability to assess perceived susceptibility as a motivator of future CRC screening (Weinstein and Nicolich, 1993). For example, some individuals are motivated to attend preventive screening because they think that they are at increased risk for CRC (e.g., due to lifestyle or familial factors), however others are motivated to screen because they typically engage in frequent multiple health behaviors, even though they do not think they are at increased risk for CRC. The only way to disentangle this association between perceived susceptibility and CRC screening is to conduct prospective studies because of the inherent confound between accuracy of reporting perceived susceptibility and perceived susceptibility as a motivator for screening (Gerrard *et al.*, 1996). In addition, cross-sectional designs cannot answer the question of directionality of the relationship between perceived susceptibility and CRC screening. For example, those individuals who have previously received negative results on CRC screening may view themselves at lower risk for CRC, which in fact may be true for negative results or removal of polyps from a flexible sigmoidoscopy and/or colonoscopy. Therefore, in a cross-sectional design we cannot conclude whether perceived susceptibility motivates CRC screening, or CRC screening affects perceived susceptibility. Among our participants, 67.6% reported that their perceived susceptibility to CRC was similar to others of the same age, leading to a restricted range

of responses and could be another potential explanation for nonsignificance regarding perceived susceptibility. On the other hand, perceived susceptibility may not be a significant or important barrier for CRC screening and may need to be further explored (Blalock *et al.*, 1990; Burack and Liang, 1987; Halper *et al.*, 1980; Lipkus *et al.*, 2000; Macrae *et al.*, 1982; Manne, 2002).

We also examined physician recommendation for CRC screening, a potential cue to action within the HBM. Physician recommendation for CRC screening was highly related to screening adherence. This finding is consistent with a large literature on the importance of physician recommendation for CRC screening (Manne, 2002, Manne *et al.*, 2002; Myers *et al.*, 1990). However, 81.7% of women in this study reported that they had received a physician recommendation for some type of CRC screening, but only 50% were adherent, indicating that physician recommendation may be necessary but not sufficient for CRC screening adherence.

In part, the importance placed by the HBM on perceived benefits and barriers was confirmed, given their strong relationships with CRC screening adherence. However, when we examined the updated HBM, there was no evidence to confirm benefits and barriers as mediators, and thus did not support the updated HBM. In our study, the relationships between self-efficacy, severity, and physician recommendation remained significantly related to CRC screening adherence, even after perceived benefits and barriers to CRC screening were included as mediators. Finally, we did provide support for perceived benefits of and barriers to CRC screening, physician recommendation and screening self-efficacy, and were able to explain 40% of the variance in CRC screening adherence. Our proportion of explained variance is similar to findings from a recent study that reported that perceived susceptibility, worry about bowel cancer, perceived barriers, and perceived benefits explained 47% of older adults' interest in bowel cancer screening (Wardle *et al.*, 2000). However, our predicted variance was higher than another CRC adherence study that reported that perceived barriers and perceived susceptibility only significantly predicted 12% of FOBT testing adherence, while perceived severity was not significantly related to FOBT acceptance (Macrae *et al.*, 1984).

Several limitations of this study should be taken into consideration when interpreting these findings. Our study utilized a cross-sectional design, thereby limiting our ability to investigate causal relationships between variables. In addition, our data were self-report for adherence to CRC and collected retrospectively and therefore are subject to potential recall bias or false reporting. The participants in our study consisted solely of older women who were predominantly Caucasian, well-educated, of higher socioeconomic status and who had access to health insurance and health care.

Thus, we cannot generalize to diverse or underserved populations, or to men. It also limits our ability to investigate any possible gender differences in health beliefs and behaviors. Another potential limitation concerns the global nature of the outcome variable (i.e., that we operationalized CRC screening adherence and future intentions for CRC screening, rather than for FOBT, flexible sigmoidoscopy, and colonoscopy separately). An alternative measurement strategy, specifically assessing for each CRC screening behavior, might have improved our ability to identify adherent individuals, by reminding participants of the exact test they may have undergone for screening. One strength of our outcome measure was that we asked specifically about screening and not about diagnostic tests per se. If we had asked about undergoing flexible sigmoidoscopy or colonoscopy in general, we would have confounded screeners with symptomatic women who underwent testing solely for diagnostic purposes, an error that has drawn attention recently in the screening literature (Baier *et al.*, 2000). Thus, we avoided language that would confound diagnostic measures with screening measures (Campbell, 2002).

Despite these limitations, the present study points to multiple covariates of CRC screening as guiding issues for health education interventions to promote CRC screening. Our findings may be relevant for designing future interventions to increase CRC screening, through increasing physician recommendations, screening self-efficacy, and benefits and reducing barriers to CRC screening. The updated HBM may be clinically and theoretically useful because it explores the process by which factors in the HBM motivate behavior change and may also inform future clinical interventions (Manne, 2002). However, the updated HBM may be best and most accurately examined as a useful model in explaining CRC screening adherence in prospective studies. Research investigating significant covariates related to CRC screening adherence is at an early and exciting stage, therefore future empirical and theoretical research should include examining combinations of existing theoretical models as well as testing new models (Stefanek, 2002). In addition, utilizing perceived susceptibility as a significant covariate in the models of CRC screening should be reevaluated, especially if this relationship is not borne out in prospectively designed investigations. However, given the early stage of this research, the present study is considered a good empirical and theoretical beginning in understanding CRC screening adherence among women. Future research should further examine and refine measures of perceived benefits and perceived barriers of CRC screening, given the recent availability of validated scales (Manne *et al.*, 2002; Rawl *et al.*, 2001). Future research should also longitudinally examine the predictors of both CRC screening among both men and women, attempt to identify other cues to action besides physician recommendation, and implement and evaluate the

effectiveness of intervention programs for CRC in order to comprehensively prevent and detect one of the most common yet treatable cancers.

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