Multilevel Intervention to Increase Breast and Colorectal Cancer Screening

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Introduction

Breast cancer (BC) and colorectal cancer (CRC) together account for 22% of all cancer deaths among United States (U.S.) women, despite the fact that guideline-based screening could significantly reduce mortality from both cancers [1]. Currently, BC and CRC screening rates are similar among U.S. women, with 64% having completed BC screening in the past two years and 62.2% adherent to CRC guidelines [2]. Current recommendations for average risk women include mammography either annually (screening can start at age 40) or biannually (for those aged 55 and older), and the choice of multiple CRC screening tests (e.g., fecal immunological test annually or colonoscopy every 10 years) for individuals aged 50-75 (ACS, 2017, ACS, 2017).

In the last two decades, interventions to increase either BC or CRC screening have been tested using a wide variety of interventions, including tailored messages delivered via print, telephone, or computer-based programming [3-10]. Most studies have found that tailored messages significantly increased screening and that interventions with two modalities (e.g., print and telephone) were generally more effective than a single contact. Although interventions targeting single cancer screenings have dominated the research literature, a few researchers have investigated interventions to simultaneously increase BC and CRC screening in individuals who were non-adherent to either mammography, CRC screening or both. In a multipronged stepped intervention, low-income participants were randomized to an intervention or usual care. The multilevel intervention consisted of mailed letters, automated telephone messaging, mailed fecal Immunochemical kits, and point-of-care prompts. The intervention significantly increased BC screening and CRC screening with the biggest increase realized in CRC screening after mailed receipt of an FOBT kit [11]. A second study with primary care patients who were overdue for either mammography or CRC screening randomized patients to either personalized mailed letters, automated telephone calls or a combination of both which included messages for the needed screening (mammography, CRC screening, or both). Researchers found that the intervention combining a personalized letter and automated call compared to an intervention using either letter or automated call alone resulted in significant increases in mammography and CRC screening [12]. Most recently, a two-group delayed treatment study randomized 116,407 Medicaid participants who were overdue for mammography or CRC screening or both to receive a mailed persuasive messaging with a telephone support to reduce barriers and schedule appointments coupled with a $20 incentive if screening was completed. Unique mailers were sent for mammography and colonoscopy; therefore, if a woman was overdue for both screenings, two mailers were sent. Letters for CRC screening prompted a colonoscopy although a footnote indicated that they could talk to their doctor about stool tests as alternative to colonoscopy. Both receipt of a mammogram and colonoscopy were significantly higher in the treatment group than control [13].

Theoretically, an individual who completes one health behavior is more likely to complete a second [14]. Both breast and colon cancer share common risk factors such as age and family history, and not surprisingly, research has demonstrated that screening behaviors for BC and CRC are positively correlated [15]. Although some cancer screening interventions have included both BC and CRC screening messages simultaneously,

most have delivered separate messages for each screening and analyzed outcomes separately, not capitalizing on the potential that increasing one screening may enhance the intervention effect on the other. One study which used a combined intervention delivered simultaneously, randomized women from federally qualified health clinics in rural Louisiana who were non-adherent to both breast and colon cancer screening. Women were randomized to enhanced care, health-literacy informed education, or health literacy informed education with nurse support. The combination of health literacy education and nurse support was more than two times more effective in increasing both screenings than health literacy-informed education only [16].

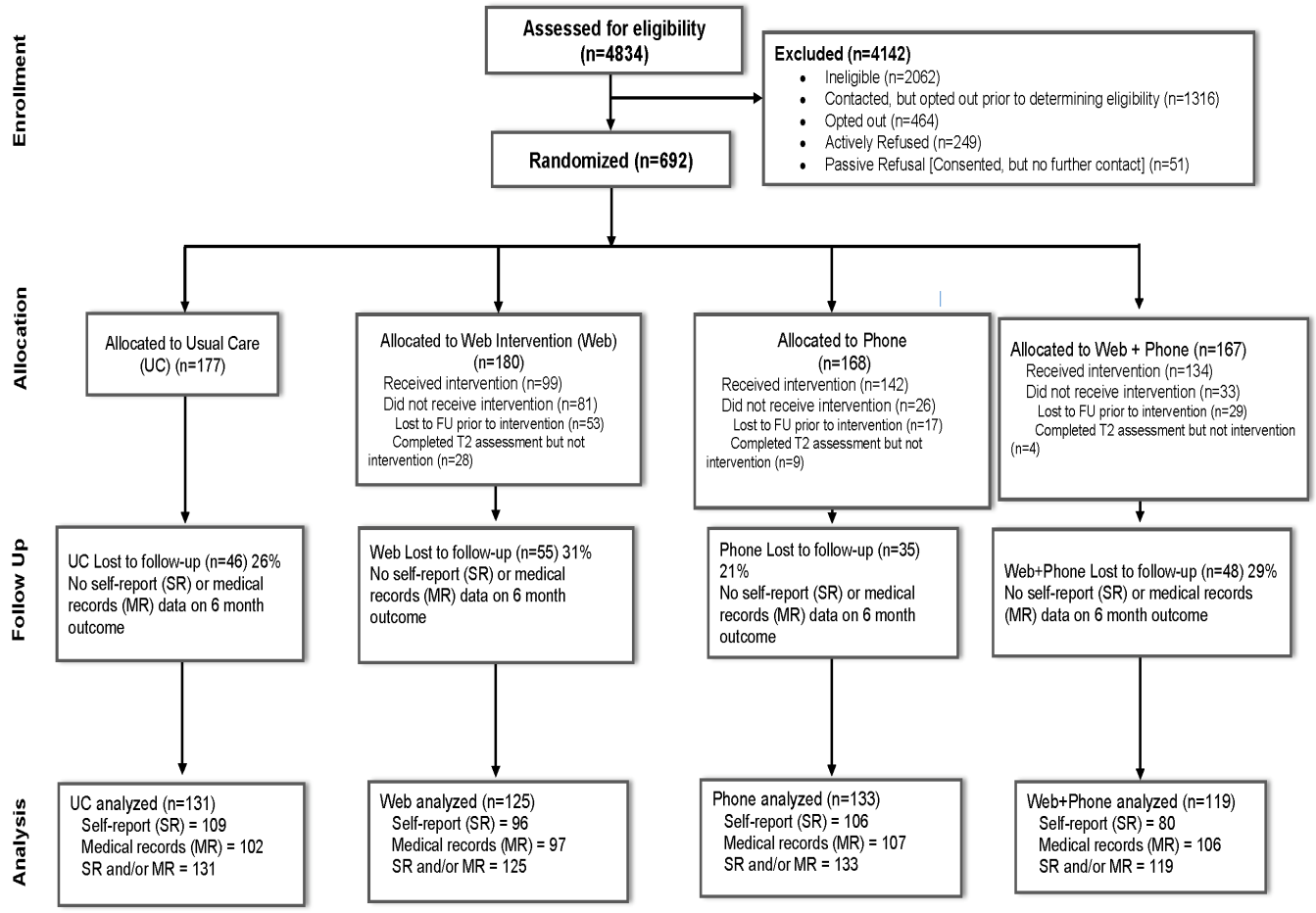
The current randomized prospective trial supported by the National Cancer Institute sought to simultaneously increase both BC and CRC screening in women who were non-adherent to both screening behaviors. A two by two factorial design was used to test tailored content delivered by a web intervention, a phone intervention, or a combination of both the web and phone intervention compared to usual care. Tailored intervention content included messages for perceived and actual risk, knowledge, benefits and barriers to screening, self-efficacy, test preference, and access to obtaining a stool blood test or information promoting scheduling mammography or colonoscopy. If women had a strong family history of CRC, they were defined as higher than average risk and the intervention focused on colonoscopy as the recommended CRC screening modality [17, 18]. Our primary outcome was receipt of a mammogram and/or a stool blood test or colonoscopy. Research questions that guided the study for this dual outcome intervention were:

1. Is there a difference, while controlling for baseline characteristics, between usual care and the intervention arms (Web, Phone, or Web + Phone intervention) on adherence to obtaining: 1) either a mammogram or CRC screening, or 2) both a mammogram and CRC screening?
2. Were women who became adherent to mammography by 6 months post-intervention (at T3) more likely to be adherent to any CRC screening at T3, in the overall sample?

Methods:

Study Design*:* Women were enrolled in a prospective, randomized control trial with three tailored interventions and outcomes assessed at 6 months as described in detail elsewhere [19]. The design is illustrated in Figure 1. In brief, medical records were reviewed for evidence of colorectal or breast cancer screening and women who did not have medical verification of screenings were listed in an encrypted file that was sent to a Survey Center supported through Indiana University. The Survey Center sent mailed letters explaining the study with a postage paid opt-out postcard allowing women to return a postcard or call an 800 number if they did not want to be contacted. Women who had not opted out by two weeks were called by

Figure 1: Consort Diagram

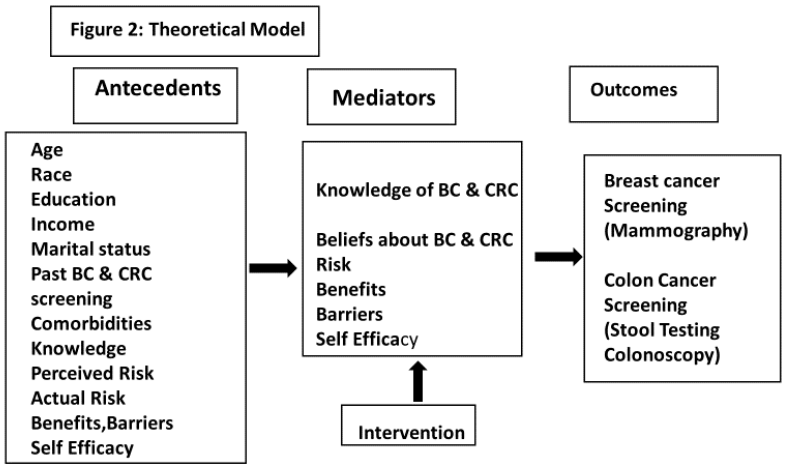


the Survey Center and if they expressed interest, verbal confirmation of breast and colorectal cancer screening status was obtained by trained interviewers. Following verbal consent, women were randomized to one of four groups*:* (1) usual care, (2) tailored Web-based, (3) tailored phone counseling, or (4) a Web-based phone counseling intervention. Women were interviewed at baseline and 6 months after intervention. A Health Portability and Accountability Form (HIPPA) was mailed to enrolled participants for signature and return in a stamped envelope to allow investigators to access medical records at six months. Participants also had the opportunity to complete the medical records release form on line. Women were surveyed at baseline, 4 weeks and 6 months. Medical records were abstracted at 6 months to confirm self-report screening data. A $20 gift certificate was mailed to participants following each data collection. The study was approved by the institutional review board at Indiana University and community sites. *T*his study is registered with the clinical trials identifier NCT03279198 at https://clinicaltrials.gov/show/ NCT03279198.

Sample Eligibility: Women ages 50 to 75 years who were nonadherent to CRC screening guidelines and had access to the Internet were eligible to participate. Nonadherence was defined by: having had neither: 1) a fecal occult blood test or a fecal immunochemical test in the last 15 months; or 2) a sigmoidoscopy more than 5 years

ago; or 3) a colonoscopy more than 10 years ago, and 4) not having a mammogram in the last 15 months. Women were excluded from the study if they had: (1) a personal history of colorectal cancer, colorectal polyps, or inflammatory bowel disease, and (2) any medical conditions that would prohibit colorectal cancer screening. At baseline, information on family history of colon cancer and breast cancer was obtained.

Study Intervention: The three study interventions arms included: 1) tailored web-based program, 2) tailored phone counseling, or 3) a web-based program plus phone counseling intervention. The tailored messages supporting the interventions were developed based on the Theory of Planned Behavior, Health Belief Model, and Transtheoretical Model which identified demographic variables, knowledge and beliefs and past experiences to predict behavior change [20-25]. Figure 2 outlines the theoretical model used to develop the interventions.



Web based intervention: The web-based program was built to provide tailored messages based on the individual's knowledge, perceived and actual risk to breast and colon cancer, and benefits and barriers and self-efficacy to both breast and colon cancer screening. Questions to identify individual demographics and beliefs were queried throughout the program and triggered an algorithm that selected and delivered messages tailored to each woman's response. Based on the women's risk profile, women at higher than average risk to colon cancer received an intervention that encouraged colonoscopy, whereas women at average risk were allowed to select either stool test or colonoscopy followed by program content consistent with their preferred test. Different forms of visual aids were used and included video clips to illustrate the screening procedures of mammography, stool tests and colonoscopy. Audio dialogue accompanied each question, allowing women with low literacy to use the program. The web-based program had a talk show format.

Telephone Intervention: A phone based tailored intervention was developed to deliver tailored messages consistent with the Web-based programing that outlined message content which paralleled the web-based program. The intervention was delivered by a trained research associate with an average call time of 20 minutes. Phone interventionists were trained during a 2-day program with role playing. With the consent of the participant, all telephone interventions were audio recorded and for quality control the audio tapes were later reviewed for appropriate delivery of content using a fidelity checklist.

Web + Phone intervention: The combined intervention prompted women to first complete the Web program followed by the phone intervention that was delivered two to four weeks later. The average time for delivery of the phone intervention in this arm was similar to the average time used to deliver the phone intervention alone (19 minutes).

Usual Care: Women randomized to the usual care group did not receive an intervention; however, women received usual care from their health care providers and depending on the provider may have received a postcard reminder for cancer screenings.

Measures: Demographic variables, family history, and cancer screening history were assessed using standard questions at baseline and at 6 months. Screening belief factors were assessed with scales that have been developed and tested for validity and reliability in past research [26-28]. The belief scales assessed perceived risk, self-efficacy, fatalism, fear as well as benefits and barriers to breast and colon cancer screening. Intent to screen for breast and colon cancer were assessed by questions used in past research [29].

Outcomes of Interest: The primary outcome at 6 months was: 1) receipt of either a mammogram or CRC screening (stool test or colonoscopy) or 2) receipt of both a CRC screening test and mammogram. The outcomes were assessed with a combination of a 6-month self-report and medical records audit (See Figure 2). Use of both self-report and medical record data served to decrease potential bias due to missing data in either interview or medical record information. The Kappa coefficient of agreement for adherence between self-report and medical records for mammography was XX. The Kappa coefficient of agreement between self-report and medical records among those who had both sources of data was 0.76 and 0.85 in our sample, respectively, for stool test and colonoscopy. in our sample. If either self-report or medical records indicated that a screening test was received, the outcome variable was scored as “yes”.

Study Outcomes and Statistical Strategy:

The three groups were compared for distributional properties on baseline characteristics using the Kruskal-Wallis test for continuous and ordinal variables and two-sided Fisher’s exact test for nominal categorical variables. A binary logistic regression was used for analyses of intervention effect. Demographic and other theoretically based variables were entered as potential confounders of the relationship between the interventions and mammography adherence [30]. Wald chi-square tests, adjusted odds ratios, and 95% confidence intervals were used to test independent variables and covariates in the logistic regression models. Interactions between the intervention and baseline covariates were tested for potential moderating effects. All tests were two sided, using alpha of 0.05, except moderating effects which were tested using alpha of 0.01 because they were considered exploratory. The study was designed to achieve a sample size of at least 100 in each of the three groups at six months, for program B participants, considering attrition, in order to insure at least 80% power to detect 20% differences in six months screening between any pair of randomized groups. See Table 1 for the actual sample size unadjusted for covariates, and Table 2 footnote for actual sample for models adjusted for covariates which was slightly greater on average than 100 per arm. An intent-to-treat analysis was used (i.e. participants were analyzed according to randomized groups regardless of behavioral dosage of intervention received and the study team attempted to obtain medical-record-based screening outcomes including on participants who were missing their follow-up interviews).

Results

Sample

A total of 692 women met eligibility, signed a written consent, and were randomized to one of four groups (See Figure 1). Baseline characteristics are described in Table 1. Randomized groups were significantly different at the .05 level for the number the times they saw a health care provider in the past year, total number of self-reported health problems, depression limiting activities, and BMI which were included as covariates along with other theoretically potentially confounding baseline variables. The average age for women across intervention groups was 58.7 (SD=6.0). Over 28% completed at least 4 years of college, 43% completed some college, and 29% completed high school or less. Most women were Caucasian (85%). Of note, only 26% were included in the normal BMI category, while 27% were considered overweight and 47% were obese.

Research Question 1: Is there a difference, while controlling for baseline characteristics, between usual care and the intervention arms (Web, Phone, or Web + Phone intervention) on adherence to obtaining 1) either a mammogram or CRC screening, or 2) both a mammogram and CRC screening?

Table 2 illustrates results for Research Question 1 while controlling for baseline-imbalanced variables and theoretically potentially confounding covariates. Odds ratios are listed by intervention groups for receipt of either mammogram and stool test or mammogram and colonoscopy or receipt of both. Tests for receipt of either mammogram or stool test by randomized group indicated that all intervention arms were significantly different from Usual Care: 1) Web $p<.0249$; 2) Phone $p<.0001$; and 3) Web + Phone $p<.0001$. However, when considering receipt of either mammogram or colonoscopy, intervention arms did not differ significantly from Usual Care.

The second part of Research Question 1 was to determine if intervention groups differed when the outcome was receipt of both BC and CRC screening (either stool test or colonoscopy). When considering the outcome of receiving both mammogram and stool test, all intervention arms were significantly different from Usual Care: 1) Web, $p<.0249$; 2) Phone, $p<.0003$; 3) Web + Phone, $p<.0001$. When considering both a mammogram and colonoscopy, intervention groups did not differ from Usual Care. No moderation effect was found for analyses of Research Question 1.

Research Question 2: *Were women who became adherent to mammography at T3 more likely to be adherent to any CRC screening at T3, in the overall sample?*

A binary logistic regression model was used to test the association between adherence to BC screening and CRC screening. Stool test or colonoscopy at T3 were the dependent variables. The independent variable of interest was T3 mammography screening, and the baseline characteristics were adjusted for as in the earlier models. There was no significant interaction between T3 mammography screening and group; i.e., the association between T3 mammography screening, and either T3 stool screening or T3 colonoscopy screening, was not statistically different for the randomized groups. Therefore, Table 3 displays results for the entire sample. As illustrated in Table 3, women in the overall sample who became adherent to a mammogram at six

months post-intervention were not more likely to complete a stool test (p<.1574) but were over 4 times more likely to complete a colonoscopy (p<.001) while controlling for demographic and theoretically important variables.

Discussion

When testing an intervention that was designed to simultaneously increase adherence to both breast and colon cancer screening, all three intervention arms significantly increased women getting either a mammogram or a stool test and also increased the receipt of both a mammogram and stool test. However, the intervention arms varied in effectiveness. Women in the Web only intervention were over twice as likely to receive at least one screening(mammogram or stool test) while women in an intervention arm who received a phone call were five to six times more likely to receive at least one of the screenings. The obvious efficacy of the phone component in promoting either breast or stool testing over Web or usual care was probably influenced by the telephone interventionist offering a mailed stool kit to be returned in a postage paid envelope. Although the Web intervention group had the opportunity to receive a mailed stool kit, the Web intervention required participants to call a toll-free number and actively request a stool test be mailed to their home. Interestingly, when considering receipt of either a mammogram or colonoscopy, intervention groups were not significantly different from usual care. Neither the tailored Web intervention nor the interventions including personal contact by phone increased colonoscopy.

Two issues may be relevant to the significant intervention effect on stool test. First, average risk women, comprised XX Sue % of the sample, and these women were allowed to select either a stool test or colonoscopy to complete CRC screening. Average risk women were given a choice of CRC screening test, and the majority (XX%) selected stool testing as their preferred screening test. Myers (2007) found that those with a personal preference for stool test compared to colonoscopy were more likely to be screened following a personal navigation, which was essentially the active component of the phone intervention [31]. Other research has found that directly mailing stool test kits significantly increased CRC screening rates [32]. In contrast, a multimodal intervention in a safety net primary care practice, found a significant increase in CRC screening in intervention compared to control (37.7% vs 16.7%) when participants were allowed to select type of CRC screening and in this study approximately half of participants opted for a colonoscopy [33] Therefore, when the preferred CRC screening test was a stool test, interventions significantly increased receipt of either breast or CRC screening compared to controls.

The overall purpose of developing interventions targeting dual screenings was to simultaneously increase both screening for breast and colorectal cancer and all intervention arms were significant in increasing the likelihood of a woman receiving both a mammogram and stool test. As was the case with receiving only one of the two interventions, the intervention arms which included a phone contact had over twice the effect of the Web intervention alone.

It is interesting to note that the intervention effect for increasing both mammogram and stool test simultaneously had greater odds ratios than those associated with increasing only one screening in all intervention arms. Women in the Web intervention arm were over 5 times more likely to receive both a mammogram and stool test compared to usual care while women in the Phone intervention were over 13 times more likely than Usual care and women in the Web+ Phone intervention were over 18 more likely to receive both screenings. In a study in underserved counties in South Carolina, Davis studied the effect of an intervention to simultaneously increase both mammography and stool testing comparing educational materials delivered in clinic with and without adding nurse navigation. All patients received a stool kit at clinic visit. The nurse supported arm showed a significantly greater increase in obtaining both screenings than either of the compared intervention arms although all groups received a stool kit [16]. Since the intervention arms which included personal navigation via phone also included automatic mailing of a stool test, we cannot unravel the effect that personal contact had compared to automatic receipt of a stool kit. Our prior analyses demonstrated that significant interventions effects were probably due to mailing a stool kit [19].

An underlying assumption of this study was that promoting screening simultaneously for breast and colon cancer would be synergistic. We tested this assumption by examining the association between obtaining breast cancer screening and either stool or colonoscopy. Here we found that when women received a mammogram, they were over four and one half times more likely to receive a colonoscopy but not significantly more likely to receive a stool test. That is, receipt of a mammogram was associated with receiving a colonoscopy but not associated with receipt of a stool test. There are similarities in obtaining a mammogram and colonoscopy. Both require making an appointment outside of the normal health care visit. However, although both require an appointment and advance planning, receiving a colonoscopy is obviously more difficult than just obtaining a mammogram. Colonoscopy requires dietary restrictions the day before the test, a significant prep to cleanse the bowel, as well as having someone drive you to the appointment and wait to take you home. The time involved with receiving a colonoscopy is also much greater than a mammogram appointment which usually takes no more than 30 minutes to an hour.

To our knowledge, this is the only simultaneous intervention supporting both breast and colon cancer screening that assessed the synergistic intervention effect of obtaining both screenings. It is apparent that intervention effects differed when the outcome for colon cancer screening was stool test compared to colonoscopy.

Conclusion

The tailored intervention simultaneously supporting both breast and colon cancer screening significantly improved rates of one screening (either breast or stool test) and increased receipt of both tests in women who selected stool testing as their screening test of choice for colorectal cancer. A second question sought to determine the actual association of becoming adherent to colon cancer screening if a mammogram was received regardless of intervention effect. Surprisingly, a strong association existed between receiving a mammogram and obtaining a colonoscopy, but no association between receiving a mammogram and stool blood test. Intervention arms did not affect this association.

Limitations

Participants were insured members of two health care systems who were non adherent to both breast and colon cancer screening and who consented to be in this randomized trial. The majority of participants were Caucasian and therefore, results may not generalize to women of other racial origins. Although all women had access to a Web-based program, some women may have been more comfortable with technology than others.

Table 1: Baseline Characteristics by Randomized Group – among program B participants

Baseline Characteristics Number (%) or Mean (SD)	Total Sample (n=692)	Web (n=180)	Phone (n=168)	Web + Phone (n=167)	Usual Care (n=177)	P value
Age, mean (SD)	58.7 (6.0)	59.5 (6.2)	58.6 (6.0)	58.0 (5.8)	58.6 (6.1)	0.1243
Health site						0.6089
Regenstrief	134 (19.4)	31 (17.2)	32 (19.1)	38 (22.8)	33 (18.6)	
Community	558 (80.6)	149 (82.8)	136 (80.9)	129 (77.2)	144 (81.4)	
Highest education						0.6182
High school graduate or less	199 (28.8)	51 (28.3)	45 (26.8)	56 (33.5)	47 (26.7)	
Some college	297 (43.0)	83 (46.1)	69 (41.1)	68 (40.7)	77 (43.8)	
4 year college graduate to graduate degree	195 (28.2)	46 (25.6)	54 (32.1)	43 (25.8)	52 (29.6)	
Race						0.1495
Black or African American	78 (11.3)	23 (12.8)	16 (9.5)	22 (13.2)	17 (9.6)	
White or Caucasian	587 (84.8)	153 (85.0)	149 (88.7)	134 (80.2)	151 (85.3)	
Asian, Pacific Islander, or Other	27 (3.9)	4 (2.2)	3 (1.8)	11 (6.6)	9 (5.1)	
Married or living with a partner	384 (55.7)	91 (50.6)	106 (63.1)	91 (54.5)	96 (54.9)	0.1217
Total combined yearly household income before taxes						0.1501
$30,000 or less	243 (36.4)	72 (41.6)	51 (30.9)	66 (40.5)	54 (32.3)	
$30,001 - $75,000	262 (39.2)	66 (38.2)	75 (45.5)	56 (34.4)	65 (38.9)	
$75,001 or above	163 (24.4)	35 (20.2)	39 (23.6)	41 (25.2)	48 (28.7)	
In the past year, how many times have you seen your doctor or other HCP? (not						

counting dentist or eye doctor)						
3 or more times, n (%)	293 (42.8)	92 (51.4)	65 (38.7)	71 (42.8)	65 (37.8)	0.0397
Body Mass Index (BMI)						0.0091
Underweight / Normal	171 (25.8)	37 (21.4)	47 (29.4)	41 (25.6)	46 (27.2)	
Overweight	180 (27.2)	47 (27.2)	47 (29.4)	29 (18.1)	57 (33.7)	
Obese	311 (47.0)	89 (51.5)	66 (41.3)	90 (56.3)	66 (39.1)	
Total number of self-reported health problems, mean (SD)	1.9 (1.8)	2.1 (1.8)	1.7 (1.7)	1.8 (1.6)	1.7 (1.6)	0.0250
Does depression limit your activities? n (%) yes	61 (9.0)	19 (10.7)	11 (6.8)	24 (14.5)	7 (4.0)	0.0048
Perceived age-adjusted risk for breast cancer, n (%)						0.7415
About the same or not sure	424 (61.4)	109 (60.6)	102 (60.7)	109 (65.7)	104 (58.8)	
Higher risk	54 (7.8)	15 (8.3)	15 (8.9)	8 (4.8)	16 (9.0)	
Lower risk	213 (30.8)	56 (31.1)	51 (30.4)	49 (29.5)	57 (32.2)	
Mammography stage, n (%)						0.6352
Pre-contemplation	356 (51.5)	90 (50.0)	82 (48.8)	86 (51.5)	98 (55.4)	
Contemplation	336 (48.5)	90 (50.0)	86 (51.2)	81 (48.5)	79 (44.6)	
Has doctor or health care provider suggested you get a mammogram? n (%) yes	622 (90.5)	158 (88.8)	158 (94.1)	143 (86.7)	163 (92.6)	0.0771
Have any of your close blood relatives (parents, sisters,	120 (17.3)	25 (13.9)	32 (19.1)	36 (21.6)	27 (15.3)	0.2171

brothers, children) had breast cancer? n (%) yes						
Have 1 or more close blood relatives (parents, sisters, brothers, children) had colon cancer? n (%) yes	79 (11.4)	13 (7.2)	17 (10.1)	21 (12.6)	28 (15.8)	0.0711
Cancer and Cancer Screening Beliefs						
Fatalism	20.9 (7.0)	20.6 (6.4)	21.2 (7.6)	21.2 (7.1)	20.9 (6.9)	0.8944
Fear	22.7 (7.0)	22.7 (7.5)	22.5 (7.5)	23.5 (7.8)	22.2 (7.6)	0.5026
Susceptibility to breast cancer	6.3 (2.3)	6.4 (2.3)	6.1 (2.4)	6.3 (2.4)	6.3 (2.2)	0.5675
Benefits of mammography	13.3 (3.0)	13.7 (2.8)	13.2 (3.1)	13.0 (3.2)	13.3 (2.9)	0.1797
Barriers to mammography	27.6 (7.3)	27.6 (6.7)	27.4 (7.9)	28.2 (7.4)	27.3 (7.0)	0.6518
Self-efficacy for mammography	41.0 (5.6)	40.9 (5.6)	41.6 (5.6)	40.5 (5.3)	40.9 (5.8)	0.3346
Knowledge for mammography	4.9 (1.7)	5.1 (1.7)	4.9 (1.7)	4.6 (1.6)	5.0 (1.7)	0.0689
Mammography outcome indicators						
Has self-report data	404 (58.4)	97 (53.9)	109 (64.9)	86 (51.5)	112 (63.3)	.0242
Has medical record data	412 (59.5)	97 (53.9)	107 (63.7)	106 (63.5)	102 (57.6)	.1771
Has either self-report or medical record (best estimate)	515 (74.4)	126 (70.0)	133 (79.2)	123 (73.7)	133 (75.1)	.2685

Note. For continuous variables and ordinal income, the two-sided independent-groups t-test was used unless parametric assumptions were violated in which case the two-sided Kruskal-Wallis test was used. For categorical variables, the chi-square test was used. HCP = health care provider. CRC = colorectal cancer.

Table 2. Logistic Regression (LR) Models of 6 Month (T3) Combined Mammography and CRC Outcomes

Outcomes & Randomized Groups	Best-Estimate Data (Medical Records and Self-Report)*			
	Generalized LR Model (reference category = T3 Neither Mamm nor CRC)			
	T3 Mamm or CRC, not both		T3 Both	
	Adjusted OR	p-value	Adjusted OR	p-value
Combined Mammogram and Stool (N=470)				
Web only	2.14 (1.10, 4.15)	.0249	5.37 (1.24, 23.32)	.0249
Phone only	4.50 (2.32, 8.75)	<.0001	13.56 (3.36, 54.75)	.0003
Web + Phone	4.20 (2.07, 8.55)	<.0001	17.82 (4.22, 75.26)	<.0001
Combined Mammogram and Colonoscopy (N=474)**				
Web only	1.72 (0.88, 3.38)	.1161	1.22 (0.40, 3.73)	.7282
Phone only	1.73 (0.89, 3.37)	.1047	0.91 (0.28, 2.93)	.8674
Web + Phone	1.47 (0.73, 2.96)	.2874	1.29 (0.42, 3.94)	.6566

*Models adjusted for baseline characteristics including mammography medical record indicator, health site, age, race (African American vs Other), education, income, marital status, BMI, whether depression limits patient's activities (yes/no), family history of 1 or more blood relatives with colon cancer (yes/no), family history of 1 or more blood relatives with breast cancer (yes/no), perceived risk of breast cancer, doctor recommendation for mammography (yes/no), number of past-year primary care visits excluding eye care and dentistry (>=3), number of self-reported health problems, baseline stage of readiness for mammography, knowledge, susceptibility, benefits, fear, fatalism, self-efficacy, and barriers. Self-efficacy and barriers specific for mammography were used in all models.

**dropped doctor recommendation for mammography (yes/no) and mammography medical record indicator from baseline covariates due to quasi-complete separation if included.

Table 3. Adjusted odds ratios for having vs. not having T3 CRC screening given T3 mammography screening —among program B participants*

	Obtained T3 Mammography	
	Odds Ratio	p-value
T3 FOBT (N=470)	1.52 (0.85, 2.73)	.1574
T3 Colonoscopy (N=471)	4.59 (2.24, 9.42)	<.0001

*Models adjusted for baseline characteristics including intervention group, mammography medical record indicator, health site, age, race (African American vs Other), education, income, marital status, BMI, whether depression limits patient's activities (yes/no), family history of 1 or more blood relatives with colon cancer (yes/no), family history of 1 or more blood relatives with breast cancer (yes/no), perceived risk of breast cancer, doctor recommendation for mammography (yes/no), number of past-year primary care visits excluding eye care and dentistry (>=3), number of self-reported health problems, baseline stage of readiness for mammography, knowledge, susceptibility, benefits, fear, fatalism, self-efficacy, and barriers. Self-efficacy and barriers specific for mammography and CRC screening were used in all models.

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