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Colorectal Cancer Screening and Physical Activity Promotion Among Obese Women: An Online Evaluation of Targeted Messages

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Abstract

Obese women are at higher risk for several cancers, but are less likely than normal weight women to engage in cancer prevention behaviors such as screening and physical activity. Targeted health messages may help increase healthy behaviors among vulnerable groups such as obese women. Using findings from focus groups with obese women, the authors created targeted messages to promote colorectal cancer screening and physical activity among obese women. The messages addressed psychosocial constructs, such as benefits and barriers to colorectal cancer screening and exercise, which were relevant to the target population. Messages were tested online with women age 50 years and older (N = 181). Participants were stratified by weight (obese vs. nonobese) and randomized to review either 10 targeted (intervention) or 10 generic (control) messages. Study outcomes included elaboration about the messages, message relevance and trustworthiness, and behavioral intentions. The authors used moderation and subgroup analyses to determine whether the intervention messages were better received by certain women. They found no differences in elaboration, behavioral intentions, relevance, or trustworthiness between intervention and control for either weight group. However, exercise intentions increased more (p=.06) among inactive obese women who received intervention messages (+2.9) compared with those who were in the

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control group (+1.2). Intervention messages also produced more elaboration among women who viewed their weight as a barrier to screening or exercise. Tailoring intervention messages for obese women on the basis of behavior and barriers may improve outcomes more than giving the same messages to all obese women.

Colorectal cancer (CRC) is the third leading cause of cancer mortality among women in the United States (American Cancer Society, 2009). As with many diseases, CRC disproportionately affects certain high-risk subgroups, including obese women. A recent meta-analysis of 56 studies estimated that obese women (body mass index [BMI] ≥ 30) have a 25% greater chance of being diagnosed with colon cancer than women with a BMI of 23 or less (Ning, Wang, & Giovannucci, 2010). Obese women are also up to 46% more likely to die from colon cancer than nonobese women (Calle, Rodriguez, Walker-Thurmond, & Thun, 2003). Although there is a physiological link between excess body weight and cancer (John, Irukulla, Abulafi, Kumar, & Mendall, 2006), lower rates of cancer prevention and control behaviors may also contribute to this relationship. Obese women, particularly obese white women, have lower usage rates of several cancer screening tests (Cohen et al., 2008), including colonoscopy (Leone, Campbell, Satia, Bowling, & Pignone, 2010), the most widely used CRC screening test (Centers for Disease Control and Prevention [CDC], 2010). Obese women are also less likely to engage in regular physical activity (Davis, Hodges, Gillham, 2006; Pratt, Macera, & Blanton, 1999), another important CRC prevention behavior; a recent meta-analysis estimated that higher physical activity levels, independent of weight, could reduce colorectal cancer risk by 14% (Harriss et al., 2009).

There is limited research examining the relation between obesity and CRC screening in women. Before this study, our team conducted seven focus groups with obese women who were not up to date with CRC screening guidelines (Leone, 2010). These focus groups used the health belief model (Janz & Becker, 1984) as a guide for exploring women's attitudes and behaviors toward screening. The focus groups revealed that obese women may face barriers to screening that nonobese women do not face. For example, obese women have a higher number of comorbid conditions, such as diabetes or heart disease, which may take precedence over cancer screening. Treatment of these conditions may monopolize women's time and resources and reduce emphasis on cancer prevention. Certain medical conditions, such as diabetes, may also make screening or screening preparation more difficult for obese women. Focus groups indicated that obese women had poor knowledge of screening benefits and did not believe that their weight put them at higher risk for cancer (Leone, 2010).

Obese women also report more difficulty starting and maintaining regular physical activity (Ball, Crawford, & Owen, 2000; Genkinger, Jehn, Sapun, Mabry, & Young, 2006). Prestudy focus groups revealed several weight-related barriers to exercise. Injuries related to or exacerbated by excess body weight were among the most commonly mentioned barriers for obese women (Leone, 2010). Obese women also differed from nonobese women in their reasons for exercise. Obese women were more likely to only engage in exercise when they were trying to lose weight and did not recognize that exercise can provide benefits (e.g., disease prevention, improved quality of life) even if it does not produce weight loss. They

were also more likely to report feeling uncomfortable while exercising and less likely to say that they enjoyed it (Leone, 2010).

Interventions are needed to increase cancer prevention behaviors among obese women. Although many CRC prevention programs and messages have been developed, they may not be effectively reaching obese women; therefore, different methods or messages may be necessary. One study indicated that personally tailored printed information was more effective at increasing physical activity among obese women compared with a social support lay health advisor intervention (Leone, James, Hudson, & Campbell, 2010). Several studies have also successfully used tailored messages to increase cancer screening (A. C. Marcus et al., 2005; Campbell et al., 2004) and physical activity (B. H. Marcus et al., 1998), but tailored interventions can be expensive and require collection of extensive personal information (Kreuter, Oswald, Bull, & Clark, 2000). To address these issues while still maintaining enhanced personal relevance, some studies instead use targeted messages. Targeted messages are designed for a specific group, such as obese women, rather than one individual (Kreuter & Wray, 2003). Research and theory suggest that targeted communications are more likely to be effective than generic materials because targeted communications provide more relevant information and exclude nonrelevant material that may distract from the argument (Kreuter & Wray, 2003). It follows that when information needs are more closely met, an individual will be more likely to make desired changes in knowledge, beliefs, and attitudes and to move toward behavior change. Furthermore, well-designed targeted materials have been shown to be at least as effective, if not more effective, than tailored materials at increasing healthy behaviors (Kreuter, Oswald, et al., 2000; Kreuter et al., 2004; Myers et al., 2007; Vernon et al., 2008) and they may also be more cost-effective (Lairson, Chan, Chang, Del Junco, & Vernon, 2011; Schmid, Rivers, Latimer, & Salovey, 2008). Previous research has not tested the effects of targeted cancer prevention and control messages on the basis of weight.

The goal of this study was to determine whether, compared with nontailored (generic) messages, targeted colorectal cancer screening and physical activity messages for obese women (a) are more relevant and acceptable to the target population and (b) have greater potential to improve behavior.

Method

Study Overview

Our study used a randomized controlled design to compare targeted messages for obese women (intervention messages) with generic nontargeted messages (control messages) delivered through the internet. Targeted messages were designed to meet the informational and psychosocial needs of obese women related to CRC, screening, and physical activity. Messages were tested with nonobese (BMI 18.5–29.9) and obese (BMI 30+) White women age 50 years and older. This design allowed us to test multiple hypotheses. We hypothesized that (a) obese women who read the intervention messages would rate the messages more favorably and show greater potential for behavior change than obese women who received control messages; (b) weight group (obese vs. nonobese) would moderate the intervention effect. Specifically compared with obese women who received control messages, obese

women who received intervention messages would rate them more favorably and show greater potential for behavior change. However, we would not expect to see differences between intervention and control groups for the nonobese women. This would indicate that the messages were truly targeted by weight (i.e., they benefited obese women, but not nonobese women). We also planned several moderation and subgroup analyses to determine whether messages were more effective for women based on behavioral and psychosocial characteristics. On the basis of our findings, we may either refine our messages or our message delivery strategy.

Recruitment and Randomization

Participants were recruited to the study using two main Internet-based methods: mass e-mails and postings/advertisements on social networking sites. Recruitment advertisements invited interested individuals to " get paid $25 to review and share their opinions about colon cancer prevention messages." Advertisements directed interested individuals to a website for additional study information. Potential participants were asked to complete an eligibility questionnaire online. To be eligible, participants had to be female, age 50 years or older, have a BMI ≥ 18.5 (as assessed by self-reported height and weight), and identify as White/Caucasian. We limited eligibility to white women because previous research indicates that obesity is associated with lower screening rates among white women, but no association was seen among men or women of other races (Cohen et al., 2008; Heo, Allison, & Fontaine, 2004; Leone et al., 2010).

Potential participants were not made aware of the eligibility criteria so that there would be no incentive to falsify data. Ineligible individuals were told that they could not participate in the study but were offered information about colon cancer prevention. Eligible individuals were asked to review study information and indicate their consent to enroll. At this point, they were asked to provide an e-mail and password so that their information could be saved in the event that they were unable to complete the entire study at once. Once this process was complete, women were considered officially enrolled in the study. To ensure adequate enrollment of obese women, we stratified the sample on the basis of weight group: obese (BMI ≥30) versus nonobese (BMI 18.5–29.9). We restricted enrollment to 120 obese and 100 nonobese women with a goal of having a final sample of 200 women after dropout. After completing a baseline survey online, women within each stratum were randomized to view either the intervention or control messages.

Message Development and Content

Each woman was asked to review one of two possible message sets: generic messages (control) or targeted messages for obese women (intervention). Each message set contained 10 individual messages, each about 1–2 paragraphs long. All women in the intervention group, regardless of weight group, received messages targeted for obese women. Intervention messages were created to address the screening and physical activity topics that were most salient among obese women on the basis of focus group results. Control messages were selected to address the same general topics included in the intervention messages but were taken from the CDC's Screen for Life fact sheets (CDC, 2006), the CDC's physical activity website (CDC, 2009) and the Agency for Healthcare Research and Quality website

(Agency for Health Care Research and Quality, 2002). Both messages sets addressed constructs from the Health Belief Model (Janz & Becker, 1984) and other relevant theories; these constructs included knowledge, perceived susceptibility, perceived barriers, perceived benefits, and self-efficacy. One message pair also addressed how to improve patient–provider communication with respect to CRC screening.

Addressing barriers to screening and exercise was a main focus of both messages sets; the intervention messages addressed weight-related barriers, whereas the control messages focused on more general barriers. Weight-related barriers were based on those expressed by obese women in the prestudy focus group such as " I am uncomfortable with how I look while exercising or wearing exercise clothing" (see Table 4 for a list of these barriers). As with the barriers messages, the other intervention messages addressed aspects of each psychosocial construct that specifically applied to obese women. For example, focus groups found that most obese women did not believe that they were at higher risk for colon cancer because of their weight, nor did they see a connection between exercise and colon cancer; instead, family history was the most frequently mentioned risk factor for CRC (Leone, 2010). Therefore the targeted message addressing perceived susceptibility included information on how age, gender, weight, and exercise affect CRC risk. The message also indicated that only a small percentage of CRC is related to family history. The generic message focused on age and gender as general risk factors and detailed who is at high risk on the basis of family history of CRC or inflammatory bowel disease. The intervention (targeted) messages did not explicitly refer to the weight of the reader or give any direct indication that they were targeted toward obese women.

Data Collection

The baseline survey included questions on CRC screening and physical activity behaviors and related psychosocial measures. Immediately after reading the messages, women completed a follow-up survey where they rated the messages and repeated the psychosocial questions that they answered at baseline. Women were encouraged to complete the entire study (baseline survey, message review, and follow-up survey) at one time but had the option to save their answers and return at a later date. Before beginning enrollment of participants, we conducted a usability test of the study website with women from the target population. We found that the majority of women were able to complete the study in less than 1 hour.

The study website was available online for approximately 5 months (June 2009-November 2009). Women who enrolled but did not complete the study received 2 to 4 e-mails asking them to return to the website and complete the study. Three weeks before the study ended, everyone who had not yet completed the study received an e-mail notifying them of the last possible date for completion. They were also informed before enrollment that they would receive the $25 incentive (check or gift card) only if they completed the entire study. This study was approved by the University of North Carolina at Chapel Hill's Public Health—Nursing Institutional Review Board.

Outcomes and Measures

The main message testing outcome for the study was elaboration. Elaboration, as described by the elaboration likelihood model (ELM; Petty, Barden, & Wheeler, 2002), measures the extent to which a person is able and motivated to carefully consider a given argument. The ELM is used to explain the rationale for using targeted and tailored messages, making it an appropriate model to guide the evaluation of the messages (Kreuter, Farrell, Olevitch, & Brennan, 2000). The ELM states that an individual with high motivation and ability to process a message will have higher elaboration, and, thus, persuasion will occur through a central route. Persuasion that occurs through the central route is thought to be enduring, resistant to change, and predictive of future behavior (Petty et al., 2002). Using elaboration as our main outcome allowed for comprehensive measurement of the relevance and acceptability of the messages and their potential to lead to future behavior change. Secondary outcomes examined more specific constructs: message trustworthiness, message relevance, and change in behavioral intentions.

Elaboration was measured using an adapted version of the ELM questionnaire created by Heppner, Humphrey, Hillenbrand-Gunn, and DeBord (1995). The ELM questionnaire consists of 12 items assessing three main areas: motivation to thoughtfully evaluate the messages, ability to think about and understand the messages, and favorable thoughts about the quality of information tested. The ELM scale is designed to be summed so that the highest possible score is 84. Although there is no designated cutoff, comparatively higher scores indicate greater elaboration (i.e., more central route processing). The ELM questionnaire has been shown to be an effective measurement for changes in elaboration (Heppner et al., 1995). For this study, the scale was modified to reflect the format of the messages (written presentation vs. verbal presentation) and answer scales were modified on the basis of survey pretests with the target population. We adapted the original scale so that all of the questions were on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Three negatively worded questions (e.g., " It was difficult to understand the information in the messages") were reverse-coded so that a higher score would indicate more elaboration. Internal consistency reliability for the modified scale remained high (Cronbach's $\alpha = .81$).

We measured trustworthiness and relevance using an adapted version of questions asked in a previous colon cancer prevention study where trustworthiness and relevance of the message were shown to mediate behavior change (Ko, Campbell, Lewis, Earp, & Devellis, 2010). Both constructs were measured using a Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). We measured relevance as the sum of the following two items: "The messages were written especially for someone like me" and "The information in the messages applied to my life." We measured trustworthiness with one question item: " I believed the information in the messages."

Behavioral Intention—We measured CRC screening and exercise intentions with one item each: " How likely are you to get a CRC screening test within the next 6 months?" and " How likely is it that you will exercise regularly over the next 2 weeks?", respectively. Each item was measured on a 10-point Likert scale ranging from 1 (*not at all likely*) to 10

(*very likely*). We calculated change in intentions as the difference between baseline and follow-up ratings.

Colorectal Cancer Screening—To measure CRC screening behavior, we used a selection of validated questions developed by Vernon and colleagues (Vernon et al., 2008; Vernon et al., 2004). Survey items assessed whether participants had any of the following tests to check for CRC within the recommended timeframe: a fecal occult blood test or other stool card test in the past year, flexible sigmoidoscopy within the past 5 years, colonoscopy within the past 10 years, and/or double-contrast barium enema within the past 5 years. Marcus and others have shown reasonably good validity of self-reported CRC testing (B. H. Marcus, Emmons, et al., 1998). A woman was considered up-to-date with screening if she reported having one or more CRC screening tests within the recommended timeframe.

Physical Activity—We assessed physical activity using a self-administered version of the International Physical Activity Questionnaire–Short Form. The questionnaire scoring allows for separation of individuals into three levels of physical activity: low, moderate, and high (International Physical Activity Questionnaire Core Group, 2005) The International Physical Activity Questionnaire has been shown to have reasonable reliability and validity in diverse populations (Craig et al., 2003).

Psychosocial Constructs—In addition to the main outcomes, we looked at how the intervention affected intermediary psychosocial constructs (knowledge and self-efficacy). We also measured barriers and benefits to screening and exercise for use in moderation analyses. We measured knowledge about CRC using six questions on CRC risk (gender, age, weight) and prevention (screening, physical activity, symptoms). Possible answers included the following: “ agree,” “ disagree,” and “ don't know.” We created a knowledge score by summing all the correct answers so that the highest possible score was 6. We measured self-efficacy as follows: “On a scale of 1 to 10, how confident are you that you can [complete a stool card test/schedule and complete a colonoscopy/exercise at least five times per week for 30 minutes or more]?” Perceived barriers to CRC screening (11 items) and exercise (6 items) and perceived benefits of exercise (5 items) were measured using a 4-point Likert-type scale ranging from 1 (*agree a lot*) to 4 (*disagree a lot*). A dichotomous variable, used for analyses, combined “agree a lot” with “agree a little” and “disagree a lot” with “disagree a little.” Items were created based on previous research (Campbell et al., 2004) and prestudy focus groups.

Demographic Measures—We measured age as a continuous variable while education (high school/GED, some college/trade school, college graduate, more than college), income (<30,000, 30,000–49,999, 50,000–74,999, 75,000–99,999, 100,000+), and health insurance status (yes/no) were all categorical.

Health Measures—We measured self-reported health as “excellent,” “very good,” “pretty good,” or “fair.” Participants were asked whether they were actively trying to lose weight, gain weight, or maintain their current weight. From this question, we created a dichotomous variable: weight loss practices (trying to lose weight vs. not trying to lose weight). Only 1 participant indicated that she was trying to gain weight; thus, she was categorized as not

trying to lose weight. We asked participants whether they had any of the following comorbidities: high blood pressure, heart disease, diabetes (type I or II), arthritis, Crohn's disease, ulcerative colitis, cancer, or other. For the “other” category, participants could list their illness, and each additional illness not mentioned previously was counted as a separate comorbidity (range: 0–4). This number was added to the total number of reported illnesses to create a comorbidity variable (range: 0-6). Because more than three quarters of participants reported fewer than three comorbidities, responses of 3 or more were collapsed into one category for the final analysis.

Qualitative Measures—After reading each of the 10 messages, women were asked four open-ended questions about the message they just read. The first question, “What thoughts or questions came to mind while reading this message?” allowed us to measure elaboration in a qualitative manner. Subsequent questions focused on ways in which the message could be improved. These data are not reported here but will be used to refine messages for future use.

Statistical Analysis

We conducted all analyses using SAS version 9.2 (Cary, NC). Baseline characteristics were tabulated for all study completers. To examine the differences at baseline between obese and nonobese participates, we used chi-square tests (categorical variables) and two-sided *t* tests (continuous variables). We used two-sided *t* tests also to look at unadjusted differences between control and intervention change scores within each weight group for the outcome variables and behavioral constructs.

To test whether weight group moderated the intervention effect, we created a linear regression model with an interaction term (Weight Group × Condition) for each outcome. We also created a multivariable model for each outcome to control for confounders. All variables associated ($p<.1$) with obesity or the outcome variable of interest were considered potential confounders. The intervention condition and weight group variables were held constant in all models. If no interaction was present (i.e., p for interaction term was $\geq.1$), we eliminated the interaction term from the model and reported results on the basis of obesity status and condition alone. We used PROC GLM to calculate adjusted means for each subgroup based on covariates in the model.

We used moderation and subgroup analyses to determine whether there were certain groups for which the messages might be more effective. We tested several weight-related barriers as possible moderators of the intervention effect on elaboration using regression models that included an interaction term (Weight Group × Barrier) and controlled for weight group, barrier (agree/disagree), age and education. We conducted subgroup analyses for the intentions outcomes using only participants who were not engaging in the target behaviors. *Unscreened* individuals were those who did not report being up-to-date with screening at baseline (23 nonobese women, 31 obese women). *Not regularly active* individuals responded “no” to both ofthe following questions: “Do you currently participate in any regularly scheduled exercise?” and “Do you have any injuries or medical conditions that

have kept you from being physically active over the last 7 days?" (40 nonobese women, 33 obese women).

Results

Baseline Characteristics

Participants were 207 (109 obese and 98 nonobese) eligible women, and 181 (88 obese women and 93 nonobese) women completed the study. Of those enrolled, nonobese women were more likely to complete the study than obese women (94.9% vs. 80.7%, $p = .002$). Completers were also more likely to be up to date with screening than noncompleters (70.7 vs. 46.1, $p = .01$). Table 1 shows the baseline characteristics of the sample within each weight group. There were no statistically significant differences between intervention and control groups for any of the demographic, behavioral, or psychosocial characteristics measured at baseline.

Compared with obese women, nonobese women were older and more likely to have a postgraduate degree, have a high level of physical activity, report their health as excellent, and have no comorbidities ($p < .05$). A majority of the women in the sample stated that they were actively trying to lose weight, but the percentage was higher ($p<.0001$) among obese women (88.9%) compared with nonobese women (54.4%). Obese women also reported lower rates of CRC screening than nonobese women (65.9%, vs. 75.3%, $p = .17$), but this difference was not statistically significant.

Obese women reported lower exercise self-efficacy than nonobese women (5.2 vs. 6.3, $p = .005$). Obese women also had somewhat lower scores for exercise intentions (5.5 vs. 6.7 for nonobese women, $p= .06$). Perceived susceptibility to CRC was higher among obese women (6.0 vs. 5.3 for nonobese women, $p=.06$). However, as a group, they did not perceive their risk to be much higher than that of other women their age; a mid-range score of 5–6 out of 10 indicated that they thought they were about as likely as other women their age to get colon cancer. We observed no notable differences between weight groups for baseline screening intentions, self-efficacy, or knowledge.

Outcome Differences Between Intervention and Control

Obese Women Only—In contrast with our primary hypothesis, elaboration, intention, and trustworthiness/relevance ratings of obese women who received the intervention messages did not significantly differ from those of obese women who received the control messages (Table 2). However a subgroup analysis revealed that exercise intentions increased more ($p=.06$) among inactive obese women who received intervention messages (+2.9) compared with those who were in the control group (+1.2). For the other psychosocial measures there were few notable differences between the conditions for obese women (Table 2).

Comparison of Intervention Effect, by Weight Group—We did not find any evidence for weight as a moderator of intervention effect for elaboration, intentions, relevance, or trustworthiness. However, subgroup analyses revealed that the intervention was more effective at increasing exercise intentions for inactive obese women than it was

for inactive nonobese women (p=.01). Weight group also moderated the intervention effect on change in colonoscopy and fecal occult blood test self-efficacy (p = .02 and p = .05, respectively), but not perceived susceptibility. Table 2 shows unadjusted change scores for each weight group stratified by intervention status.

Comparison of Intervention Effect, by Agreement with Weight-Related Barriers—Women who expressed weight-related barriers at baseline had higher elaboration with the intervention messages than women who did not express such barriers (Table 3). This effect modification was significant for four of the weight-related barriers (p < .1 for the interaction): having more important health concerns than CRC screening, having other health costs, not having symptoms and only exercising when trying to lose weight. All of these barriers were specifically addressed in the intervention messages but not in the control messages. In contrast, effect modification was not statistically significant for the weight-related barriers not addressed in the intervention.

Outcome Differences Between Obese and Nonobese Women

Table 4 shows the main factors affecting elaboration scores independent of intervention received. Obese women had a higher average adjusted elaboration scores (75.5) compared with nonobese women (71.9) regardless of whether they read intervention or control messages (p = .02). In addition, we found that adjusted elaboration scores were lowest among women in the highest education group and older women. Similar to elaboration, obese women had higher relevance (p = .02) and trustworthiness (p = .047) scores than nonobese women when controlling for confounders (data not shown).

Discussion

We hypothesized that obese White women who received messages targeted to the informational needs of obese readers would have higher elaboration scores than those who received generic messages. Although we did not see significant differences in elaboration scores between intervention and control, but we did find that, compared with generic messages, targeted messages produced greater increases in intentions to exercise regularly and among inactive women. Similarly, unscreened obese women in the intervention group had greater increases in intentions to get screened for CRC, but this finding was not statistically significant. We also found that agreement with barriers that we addressed in the intervention messages was a moderator of intervention effect. Women who agreed, at baseline, to having the barriers addressed by the intervention messages had higher elaboration scores in the intervention group, regardless of their weight. These findings indicate that we may need to further narrow down our target population to include only unscreened and/or inactive obese women. Another option for increasing message elaboration may be to tailor messages on the basis of barriers expressed by participants.

Although not originally hypothesized, we found that obese women had higher elaboration than nonobese women regardless of whether they received the generic or targeted messages. It is unclear from our study why elaboration would be higher among obese women. It is possible that obese women may be more engaged by the message medium (online messages) than nonobese women; this medium was chosen because obese women in prestudy focus

groups overwhelmingly preferred to receive health information through the Internet (Leone, 2010). This may not be the case for nonobese women. Furthermore, a previous study suggests that obese individuals may respond better to less personal interventions (i.e., no human contact) such as this one (Leone, James et al., 2010). That study found tailored print messages to be more effective for increasing physical activity among obese women compared with an in-person lay health advisor intervention. In contrast, normal weight women in the tailored message intervention decreased their physical activity compared with control when they received the tailored messages. Although it is possible that demographic differences between obese and nonobese women may affect the way they reacted to messages or answered survey questions, differences in elaboration, relevance and trustworthiness scores by weight persisted even after we controlled for relevant confounders such as age and education.

This is the first study we are aware of that tests weight as a possible characteristic on which to target cancer prevention and control messages. We also offer an easy to follow and relatively inexpensive method for pretesting health messages using both qualitative and quantitative outcomes. There were, however, a few weaknesses in the study design. First, we chose to compare intervention messages to established CDC messages (control group). Intervention messages were reviewed by several women in the target population and minimally edited by our staff prior to testing, but may not have been as polished as the CDC messages. In addition, intervention messages used a more familiar tone, similar to that of a popular magazine, as opposed to the more factual tone used by the CDC messages. Differences in message tone and quality may have been more noticeable to women than the content differences that we were attempting to study.

Another shortcoming of our study is that unscreened and obese women, regardless of which condition they were in, were less likely to complete the study. This is unfortunate since these are the groups which are most in need of information about CRC cancer prevention. We sent reminder e-mails to noncompleters, but only six women who received these e-mails returned to finish the study. Overall, our sample was highly educated, reflecting the demographics of the university community from which almost half of the women were recruited. The women who chose to participate in the study were probably more inclined to seek out cancer prevention information. This was reflected in their relatively high ELM scores. Overall, women in the study also had high average rates (70.6%) of meeting screening recommendations compared with women age 50–75 years in the U.S. (62.6%; CDC, 2010). Although screening rates were on average 10 percentage points higher among nonobese women, compared with obese women, this difference was not statistically significant, most likely because our study was not powered to detect these differences.

Although our study did not find evidence that weight-targeted messages were superior to control messages among obese women as group, they may still be useful for certain subgroups of obese women. The targeted messages for obese women were created based on focus groups with older (50+), unscreened women, many of whom did not engage in regular exercise. Accordingly, the messages were most effective with unscreened, inactive women. Furthermore, the barriers and other psychosocial constructs addressed in the messages were those which were most common among obese women in the focus groups, but they were not

expressed by all obese women in the present study. Therefore the message topics may not have resonated with all obese women. In contrast, they may have resonated with some nonobese women. It may be that our target population (older, White, obese women) was too heterogeneous to elicit an intervention effect. We recommend that colon cancer prevention messages address some of the topics which are salient for many obese women, but not assume that obese women are homogenous in their informational needs. Future research should examine whether further targeting messages based on behavior or including weight-related topics in a tailoring algorithm might improve obese women's responses to colon cancer prevention and control messages.

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Table 1

Baseline characteristics for intervention and control groups stratified, by weight group

	Nonobese		Obese		
Variable	**Intervention (*n*=45)**	**Control (*n*=47)**	**Intervention (*n*=44)**	**Control (*n*=44)**	***p*** [*]
BMI, *M* (*SD*)	24.5 (3.1)	24.2 (2.8)	35.4 (5.2)	36.2 (5.7)	<.0001
Age, *M* (*SD*)	57.4 (6.2)	57.4 (4.6)	55.6 (5.5)	55.7 (5.0)	.03
Income, %					
<30,000	6.7	8.5	27.2	13.6	.06
30,000–49,999	17.8	17.0	15.9	20.5	
50,000–74,999	26.7	25.5	27.3	31.8	
75,000–99,999	26.7	17.0	11.4	11.4	
100,000+	22.2	31.9	18.1	22.7	
Education, %					
High school/GED	6.7	2.1	15.9	20.5	.02
Some college/trade school	22.2	29.8	31.8	18.1	
College	22.2	25.5	22.7	22.7	
More than college	48.9	42.6	29.6	38.6	
Uninsured, %	6.4	0	11.4	4.6	.33[**]
Up to date for colonoscopy, %	71.1	70.2	61.4	63.6	.25
Up to date for any screening, %	75.6	74.5	65.9	65.9	.17
Physical activity, %					
Low	26.8	23.9	45.5	40.9	.03
Medium	43.9	34.8	34.1	40.9	
High	29.3	41.3	20.5	18.2	
Self-reported					
health, %					
Excellent	25.5	31.1	9.1	9.1	.001
Very good	28.9	37.8	40.9	38.6	
Pretty good	19.1	26.7	31.8	40.9	
Fair	6.4	4.4	18.8	11.4	
Comorbidities, %					

	Nonobese		Obese		
Variable	**Intervention (*n*=45)**	**Control (*n*=47)**	**Intervention (*n*=44)**	**Control (*n*=44)**	***p****
0	37.8	40.4	13.6	20.5	.002
1	33.3	29.8	29.6	27.3	
2	24.4	17.0	29.6	22.7	
3+	4.4	12.8	27.3	29.6	
Currently trying to lose weight, %	48.8	58.7	85.4	92.5	<.0001

* *p* for the difference between all obese and nonobese individuals calculated using chi-square tests.

** Fisher's exact test used to account for small cell sizes.

Table 2

Intervention outcomes stratified, by weight group

	Nonobese			Obese		
Outcome variable, *M (SD)*	**Control (*n*=48)**	**Intervention (*n*=45)**	***p***	**Control(*n*=44)**	**Intervention (*n*=44)**	***p***
Message evaluation*						
Elaboration	70.2 (11.8)	71.0 (9.7)	.71	74.2 (7.3)	73.8 (9.3)	.80
Relevance	10.7 (3.0)	10.2 (3.1)	.43	11.8 (2.2)	11.9 (2.6)	.79
Trustworthiness	6.3 (1.2)	6.2 (1.4)	.65	6.7 (0.94)	6.5 (1.1)	.34
Change in colorectal cancer screening intentions						
All participants	1.1 (3.4)	1.8 (2.7)	.30	1.5 (2.5)	1.9 (2.7)	.51
Unscreened†	1.9 (2.5)	1.7 (1.6)	.83	1.7 (2.1)	2.7 (2.8)	.30
Change in exercise intentions						
All participants	0.6 (2.2)	1.2 (2.3)	.19	1.1 (3.0)	1.1 (2.3)	.91
Not regularly active‡	1.4 (1.8)	1.4 (2.0)	.98	1.2 (2.6)	2.9 (2.4)	.06
Change in colorectal cancer knowledge	1.4 (1.2)	1.6 (1.3)	.40	1.3 (1.4)	1.5 (1.5)	.68
Change in colonoscopy self-efficacy	0.51 (1.9)	−0.62(1.7)	.09	0.25 (2.1)	0.96 (2.2)	.12
Change in fecal occult blood test self-efficacy	0.15(2.1)	−0.39 (1.9)	.21	0.23 (1.8)	0.47(1.5)	.50
Change in exercise self-efficacy	0.28 (2.0)	0.27(1.5)	.98	0.36 (2.6)	0.84(2.1)	.34
Changes in perceived susceptibility	−0.30 (2.9)	−0.13 (2.7)	.78	0.23 (3.4)	0.2 (2.8)	.97

*Message evaluation measures were only collected at follow-up so mean score at follow-up is reported.

†Limited to participants who did not report being up to date with screening at baseline (nonobese: $n = 23$, obese: $n = 31$).

‡Limited to participants who reported that they did participate in any regularly scheduled exercise and did not report that they were unable to do physical activity (nonobese: $n = 40$, obese: $n = 33$).

Table 3

Adjusted* elaboration scores from moderation analyses of weight-related barriers

Weight-related barriers (*p* for interaction*)	Agree with statement		Disagree with statement	
	Intervention	Control	Intervention	Control
I have other health concerns which are more important right now than getting a colon cancer screening** (.045)	72.6	66.8	73.9	74.8
I have too many other health costs right now and can't afford to have a colonoscopy** (.01)	73.4	67.3	74.0	76.1
I don't have symptoms or feel sick, so there is no reason for me to get a colorectal cancer screening test** (.07)	74.4	61.8	73.4	73.7
Colon cancer screening tests are too embarrassing (.48)	71.9	70.0	74.9	75.0
I usually only exercise if I am trying to lose weight** (.06)	76.6	72.1	72.0	73.5
I don't have the energy to exercise (.73)	74.8	73.7	73.0	73.1
I am uncomfortable with how I look while exercising or while wearing exercise clothing (.35)	73.4	74.1	73.8	71.8
My current weight makes it difficult for me to exercise (.22)	74.1	72.0	72.9	74.4

*Adjusted scores and *ps* calculated using a multiple linear regression model to predict elaboration; model included an interaction term (Barrier × Condition) and controlled for condition, barrier (agree/disagree), age, and education.

**Barriers addressed in the intervention messages.

Table 4
Factors affecting elaboration independent of intervention condition

Model variable	Average adjusted elaboration score*	*p**
Weight group		.02
Nonobese	71.9	
Obese	75.5	
Condition		.77
Intervention	73.5	
Control	73.9	
Education		.03
High school or GED	77.2	
Some college or trade school	72.8	
College	74.2	
More than college	70.6	
Age (years)		.02
50–55	70.9	
55–60	74.6	
60+	75.7	

*Adjusted scores and *ps* calculated using a multiple linear regression model to predict elaboration.