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Message Framing and Physical Activity Promotion in Colorectal Cancer Survivors

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Introduction

Among colorectal cancer (CRC) survivors, higher levels of physical activity post-diagnosis are related to lower risk of cancer recurrence, cancer-specific and all-cause mortality (Meyerhardt & Giovannucci, 2006; Meyerhardt et al., 2009; 2006). For example, among 573 stage I to III female CRC patients, those who engaged in at least 18 MET-hours per week of physical activity compared to those who engaged in 3 or less MET-hours per week had adjusted hazard ratios for CRC-specific mortality and overall mortality of 0.39 (95% CI, 0.18 to 0.82) and 0.43(95% CI, 0.25 to 0.74), respectively (Meyerhardt & Giovannucci, 2006). Similarly, among 668 men with stage I to III CRC, those who engaged in at least 27 MET-hours per week compared to those who engaged in less than three MET hours per week of physical activity had adjusted hazard ratios for CRC-specific mortality and overall mortality of 0.47 (95% CI, 0.24–0.92) and 0.51(95% CI, 0.41–0.86), respectively (Meyerhardt et al., 2009). Due to these and other physical activity benefits (e.g., improved quality of life) the American Cancer Society advises 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic activity weekly for cancer survivors (Rock et al., 2012). Unfortunately, up to 65% of CRC survivors fail to meet this recommendation (Blanchard, Courneya, & Stein, 2008). There are mixed results from the few interventions that have aimed to promote physical activity among CRC survivors. Some interventions have increased physical activity relative to baseline (Hawkes et al., 2013; Lee et al., 2013; Pinto, Papandonatos, Goldstein, Marcus, & Farrell, 2013), whereas others have produced no significant effects on physical activity relative to baseline (Courneya et al., 2003). Most effective interventions have been resource intensive, consisting of in-person sessions conducted individually or in a group setting (Anderson, Caswell, Wells, Steele, & MacAskill, 2009; Bourke et al., 2011; Lee et al., 2013; Spence, Heesch, Eakin, & Brown, 2007). Home-based interventions have also proven effective but are still fairly resource intensive since they have relied on telephone counseling and tailoring of feedback during multiple time points (Demark-Wahnefried et al., 2012; Hawkes et al., 2013; Hawkes,

Gollschewski, Lynch, & Chambers, 2009; Ho et al., 2013; Ligibel et al., 2011; Morey et al., 2009).

Studies that target inactive CRC cancer survivors using minimally-intensive interventions (e.g., a single telephone call or brief counseling session, or educational brochures) to promote physical activity more broadly and affordably are needed. Whereas intensive interventions may be needed for some segments of the population, less intensive interventions may be effective for cancer survivors who typically express higher levels of motivation to pursue healthful lifestyle change (Demark-Wahnefried, Aziz, Rowland, & Pinto, 2005). Previous studies have found the use of health education print brochures results in increased physical activity among breast and prostate cancer survivors (Demark-Wahnefried et al., 2007; Vallance, Courneya, Plotnikoff, Yasui, & Mackey, 2007).

Theoretical Background

The efficacy of print messages in promoting behavior change may depend on how information is framed. Consistent with prospect theory (Kahneman & Tversky, 1979), messages stressing the benefits of engaging in physical activity (gain-framed messages) have been more effective than messages focused on the disadvantages of not engaging in physical activity (loss-framed messages) (Gallagher & Updegraff, 2011; Latimer, Brawley, & Bassett, 2010).

Individuals are generally more motivated to engage in health behaviors when they believe there is little uncertainty and risk involved (Wakker, 2010). Thus it is hypothesized that gain-framed messages are more effective for physical activity because it poses little risk and uncertainty. In contrast, loss-framed messages are hypothesized to be more effective for health behaviors associated with uncertainty and risk. Among non-cancer populations, gain-framed messages have generally been more effective than loss-framed messages in physical activity interventions (Latimer et al., 2008; McCall & Martin Ginis, 2004); however, some interventions have resulted in no physical activity differences between gain- and loss-framed messages (Jones, Sinclair, Rhodes, & Courneya, 2004). Currently, there is a complete dearth of understanding effects of message framing on physical activity among cancer survivors in general, and CRC survivors specifically.

In this inceptive randomized trial, we explored the effects of gain- versus loss-framed educational brochures that provided strategies to increase physical activity among inactive CRC survivors following the completion of primary therapy. Both gain- and loss-framed messages were crafted to target the main constructs of the Theory of Planned Behavior (TPB) (Ajzen, 1991). The TPB has been used to promote physical activity among colorectal cancer survivors (Ho et al., 2013; Packel, Prehn, Anderson, & Fisher, 2014; Speed-Andrews et al., 2013) and contains constructs that predict adherence to exercise among cancer survivors (Husebø, Dyrstad, Søreide, & Bru, 2013).

According to TPB, behavioral intentions are most proximal to behavior. Intentions are influenced by attitudes (i.e., one's overall evaluation of a behavior), subjective norms (i.e.,

perceived social pressure to engage or not to engage in a behavior), and perceived behavioral control (i.e., individual's evaluation of personal control over a behavior).

In this study, we compare the effectiveness gain- vs. loss-framed messages targeted at TPB constructs to increase physical activity among CRC survivors. We hypothesized that gain-framed messages would be more persuasive than loss-framed messages at promoting physical activity.

Methods

Study participants/recruitment

Study inclusion criteria were: 1) patient ages 18 and older with diagnoses of early stage (I or II) CRC who had adequately recovered from surgical excision of cancer and completed adjuvant therapy (if appropriate) within the previous six months to five years; 2) no evidence of recurrence; 3) no pre-existing medical condition(s) that precluded adherence to an unsupervised physical activity program (e.g., severe orthopedic conditions, scheduled for a hip or knee replacement within 6 months, paralysis and/or dementia, unstable angina, or who had experienced a heart attack, congestive heart failure, pulmonary conditions that required oxygen or hospitalization within 6 months); 4) approved for contact by their oncologic care physician; 5) community dwelling, i.e., not residing in a skilled nursing facility; 6) English-speaking and writing and who had completed the 5th grade or higher; and 7) inactive (i.e., participating in less than 150 minutes of moderate or strenuous intensity physical activity per week).

Potential study participants were recruited from the Duke University Medical Center's Tumor Registry (DTR) and the North Carolina Central Cancer Registry (NCCCR). Upon receipt of names and contact information, potential study participants received an invitation packet that included a consent form, a screener questionnaire that assessed eligibility, and a self-addressed stamped envelope to return the completed screener and consent. Upon receipt of the screener, those found eligible were telephoned for a baseline survey. Those who did not return the screener within two weeks were contacted to complete the screener via telephone. Subjects deemed eligible provided verbal consent for participation and completed the baseline survey (see Measures). The study proscribed to state and national ethical standards, and was approved by the Duke University School of Nursing Center and Medical Center IRB. Informed written consent was obtained from the CRC survivors.

Intervention

All participants received a single page tri-folded educational pamphlet with an insert that had four main sections: 1) tips on how to become more physically active (e.g., get friends and family to help, blocking-off time on your daily calendar) with examples of activities of moderate-intensity physical activity; 2) description of other diseases for which CRC cancer survivors are at increased risk (e.g., heart disease, diabetes and second cancers) and the protective influence of physical activity on these co-morbid conditions; 3) description and results of two epidemiological studies that showed a significant inverse relationship between self-reported physical activity and risk of cancer-specific mortality and all-cause mortality in

colon cancer survivors (Meyerhardt et al., 2006; Meyerhardt & Giovannucci, 2006); and 4) a summary of benefits of being or disadvantages of not being physically active. The primary framing manipulations occurred for the latter two main sections (i.e., # 3 and #4) -- see Table 1 for examples of messages targeting TPB constructs for each framing condition. Two gender-specific focus groups of 4–5 CRC survivors per group were used to solicit input to develop these materials. The revised brochures were then re-evaluated by focus group participants for clarity and comprehensiveness before their use in the trial.

Measures

Physical activity and physical activity intentions were assessed through surveys at baseline, 1- and 12-months post intervention. Attitudes, subjective norms and perceived behavioral control were also assessed at baseline and 1-month post intervention. Standard procedures for assessing TPB constructs were used and are detailed below (Ajzen, 2011). At all time points, questions were asked in reference to engaging in regular exercise during the next month defined for participants as “any exercise sessions that last more than 30 minutes, during your free time, at least 3 times a week.” TPB constructs of attitudes, subjective norms, and perceived behavioral control were validated previously with cancer patients (α 's >.73) (16). Participants received \$10.00 for completing each survey (\$30 total).

Physical activity—Self-reported physical activity was evaluated using the Godin Leisure-Time Exercise Questionnaire (GLTEQ), to assess weekly minutes of aerobic physical activity (Godin, 2011). The GLTEQ lists three questions that assess the average frequency of mild (minimal effort, no perspiration), moderate (not exhausting, light perspiration), and strenuous intensity (heart beats rapidly, sweating) physical activity during free time in a typical week. We asked participants to indicate the average duration (in minutes) within each physical activity intensity level during the last week. Separate scores were calculated for total physical activity minutes, as well as sub-categories of strenuous, moderate and mild intensity physical activity. In line with the American Cancer Society's and the American College of Sport's Medicine's recommendation that cancer survivors should engage in at least 150 minutes per week of moderate intensity physical activity (Rock et al., 2012; Schmitz et al., 2010), we assessed the proportion of survivors who met this minimum standard by message frame. The GLTEQ is demonstrated to be a reliable instrument to assess physical activity in cancer survivors (Amireault, Godin, Lacombe, & Sabiston, 2015).

Attitudes—Six bipolar scales: unenjoyable vs. enjoyable; harmful vs. beneficial; boring vs. interesting; foolish vs. wise; unpleasant vs. pleasant; and bad versus good were used to assess physical activity attitudes. Items were rated on Likert scales (from 1 =strongly disagree, to 7= strongly agree), summed and then averaged.

Subjective norms—Three items assessed subjective norms: “Most people who are important to me... 1) think I should exercise regularly over the next month; 2) would encourage me to exercise regularly over the next month; and 3) would approve of me exercising regularly over the next month.” Items were rated on Likert scales (from 1 =strongly disagree, to 7= strongly agree).

Perceived behavioral control (PBC)—Three questions assessed PBC: 1) “If you were really motivated, exercising regularly over the next month would be (from 1=extremely hard, to 7=extremely easy);” 2) “If you were really motivated, how confident will you be at exercising regularly over the next month? (from 1=not at all confident, to 7=extremely confident);” and 3) “If you were really motivated, how much control do you feel you have over exercising regularly over the next month?” (from 1=very little control, to 7=complete control).

Intention—Three questions assessed physical activity intention: 1) “How motivated are you to exercise regularly over the next month?” (from 1=extremely unmotivated, to 7=extremely motivated); 2) “I intend to do everything I can to exercise regularly over the next month.” (from 1=strongly disagree, to 7=strongly agree), and 3) “How committed are you to exercise regularly over the next month?” (from 1=extremely uncommitted, to 7=extremely committed) (Rhodes, Blanchard, Matheson, & Coble, 2006).

Evaluation and use of the brochures—At the 1-month follow-up, participants rated their brochure on usefulness and accuracy (from 1=not at all, to 7=extremely), how much they read (from 1=not at all, to 7=read it all) and whether they reviewed the brochure with anyone (no/yes).

Manipulation check—At the 1-month follow-up, participants were asked, “Overall, to what extent did the brochure focus on the benefits you gain from exercising regularly or the disadvantages of not exercising regularly” (from 1=emphasized benefits, to 7=emphasized disadvantages).

Data Analyses Strategy

As with many studies that focus on physical activity (Demark-Wahnefried et al., 2014), several of our study measures were non-normally distributed, so we explored both parametric (t-tests) and non-parametric (Wilcoxon rank-sum tests) methods to evaluate frame effects. In general, both methods supplied similar inferences, so for simplicity we display results from the parametric analyses. In contrast, all change scores were normally distributed, so no adjustments were necessary. Hypothesis tests were evaluated using t-tests and Ordinary Least Squares (OLS) analysis, the latter was associated with repeated measures (i.e., pre-post) linear models to test changes in mean minutes of physical activity and changes in means of the TPB variables by frame. Unadjusted associations (e.g., changes in minutes of physical activity with changes in TPB constructs collapsing across framing condition), were evaluated using Pearson correlations. To identify clusters of individuals following similar progressions of minutes of physical activity, group base trajectory modeling was conducted using the SAS Proc TRAJ method of Jones and Nagin (Jones, Nagin, & Roeder, 2001). Finally, we tested whether frame type (gain or loss) was associated with gender, type of cancer (colon vs. rectum), time elapsed since diagnosis and sharing of the brochures to affect total (moderate plus strenuous), strenuous, and moderate levels of physical activity, controlling for baseline values. All the aforementioned analyses were conducted using SAS (Version 9.2, Cary, NC).

Results

Accrual of Participants

A total of 1777 invitation packets were posted to survivors in 17 states. Accrual is shown in the CONSORT diagram in Figure 1. Ultimately, among the 420 who responded, 160 (38%) were found eligible of which 156 consented; of those who consented, 148 completed the baseline survey, were randomized and sent a gain or loss-frame brochure, and 137 (92% of those randomized) completed the 1-month follow up (n=72 gain) and 111 (75% of those randomized) completed the 12-month follow-up (62=gain). Characteristics of the study sample are presented in Table 2. There were no significant differences between participants who completed and did not complete the 1-month or 12-month follow-up phone survey on arm assignment, or medical, and demographic characteristics.

Manipulation check

As intended, the gain-frame brochure was perceived as emphasizing the benefits of regular physical activity, while the loss-frame brochure was perceived as emphasizing the disadvantages of not exercising regularly ($M=1.8$ vs. $M=2.7$, respectively, $t=2.57$, $p<.02$). With respect to use and evaluation of brochures, participants in both framing conditions reported reading most of brochure ($M=6.4$ vs. $M=6.6$ [out of a maximum score of 7], respectively $t=0.94$, NS). Both the gain and loss-framed brochures were viewed as highly useful ($M=5.8$ vs. 6.1 , respectively, $t=1.73$, NS) and accurate ($M=6.2$ vs. $M=6.3$, respectively, $t=0.60$, NS).

Changes in physical activity

Effects of message framing on self-reported physical activity are presented in Table 3. There were no main effects of frame or time by frame interactions. However, across all intensity levels, mean minutes of physical activity increased at both follow-up time points relative to baseline (p -values $<.0001$). Overall, based on the trajectory analysis, 83% exhibited an increase in total minutes of moderate to strenuous physical activity relative to baseline, with mean change relative to baseline of 70 and 66 minutes/week at 1- and 12-months, respectively (p -values $<.001$). At 1- and 12-months post-baseline, 25% and 10% of survivors achieved the physical activity goal, respectively. Among those who achieved at least 150 weekly minutes of moderate-intensity physical activity at 1-month ($n=34$) and completed the 12-month follow-up, 42% ($n=11$) maintained goal (32% adjusting for attrition).

TPB constructs

In this study, baseline and follow-up measures of the TPB constructs had internal consistency scores of $\alpha > 0.70$. Neither the gain- nor loss-framed brochures produced significant changes in the TPB constructs from baseline to the 1-month follow-up, nor in physical activity intentions at 12-month follow-up (see Table 4).

Baseline predictors of changes in physical activity

Collapsing across frame, we explored which baseline TPB constructs discriminated between the group of participants who at either time point relative to baseline increased versus did

not increase their levels of physical activity. Overall, the group that increased physical activity compared to the group that did not, had higher baseline scores on subjective norms ($M=6.5$ vs. 5.9 , $p<.03$), perceived control ($M=5.9$ vs. 5.4 , $p<.05$), and stronger intentions to exercise ($M=5.8$ vs. 5.0). The two groups did not differ on attitudes.

Exploratory analyses

No significant main effects or interactions with regard to gender, age, type of cancer (colon vs. rectal), and time elapsed since diagnosis were observed.

Discussion

This study is the first to test effects of message framing, as a strategy to increase physical activity among inactive CRC survivors, to determine if this strategy merits testing in a subsequent larger randomized controlled trial. Both conditions produced significant increases in physical activity, with no differences between framing conditions. At 1-month follow-up, approximately one-quarter of previously inactive participants were meeting the national recommendations for physical activity for cancer survivors (i.e., 150 min.wk^{-1} of moderate-intensity physical activity). Overall, changes of this magnitude are noteworthy and could have major clinical and public health significance if sustained over the long-term.

An important caveat to these findings is that our study did not include a usual care group (e.g., a group that received either no information or at minimum, advice from a health care provider to exercise). As such, it remains unclear whether our message framing along with the accompanying materials did better than no information at all. It is possible that our relatively motivated and self-selected sample may have increased their level of physical activity just by being primed by our contact. However, it is unlikely that such a minimal prompt would result in an increase in physical activity of an hour a week.

We did not observe changes in the TPB constructs despite an increase in physical activity. We offer two explanations that may account for lack of change in these constructs. First, based on the manipulation check, the loss-frame brochure was not perceived as emphasizing the disadvantages of inactive behavior strongly; it may have been perceived as a milder form of the gain-frame brochure. This was expected because loss-frame messages may fail to convey the disadvantage of not exercising when combined with materials to help people be more active. Both brochures provided tips and ideas on improving health via physical activity, and both provided information on studies that found benefit with physical activity. Thus this information may have attenuated differences between gain- and loss-framed messages. Second, and perhaps the most likely explanation, is that our study participants may have been motivated prior to receipt of any materials to engage in physical activity. The mean scores of attitudes and intentions were both above scale midpoint scores of four at baseline (see Table 4). Therefore, we may have enrolled self-selected participants eager to join an exercise study. As such, our materials served equally to prime participants into engaging in physical activity (i.e., ceiling effect). The above explanation of enrolling motivated participants is consistent with the trajectory analyses, of which 83% evidenced some form of increase in physical activity. Overall, higher baseline mean scores on social norms, perceived control, and intentions all predicted increased physical activity over time.

Overall, our findings are that minimally intensity interventions, such as the use of print brochures, can be an effective means of promoting physical activity in motivated CRC survivors. Nonetheless, there is room for improvement. For example, about 18% of the sample did not show increases in physical activity in response to our interventions. For these individuals, a subsequent and more intensive intervention may be needed to boost their motivation for change, as well as their ability to adhere to the intervention. Such an approach would be consistent with a stepped or adaptive design strategy in which individuals are initially given a minimally intensive intervention (e.g., print brochure) and then assessed for meeting a criterion (e.g., reaching the physical activity goal); those not meeting goal would then be assigned a more intensive intervention (e.g., health coaching). To date, a stepped care trial has not been conducted to increase physical activity in cancer survivors.

While our study is one of the largest to date to assess the impact of a physical activity intervention on CRC survivors, and accrued and retained a diverse sample, some important limitations need to be considered. While some of these limitations have already been addressed in the forerunning discussion, others include our reliance on self-reported data (rather than objective measures), the lack of a control group, the self-select nature of our study sample, and a trajectory analysis based on a relatively small number of cases. While these limitations are minimized by our use of a well-validated questionnaire and our broad sampling approach that reached 17 states, the potential for bias remains.

In summary, our data strongly suggest that brief educational brochures emphasizing strategies to increase physical activity are well received, regardless of message frame and produced significant increases in physical activity among inactive CRC survivors. Given that brochures are used often to motivate physical activity behavior as part of usual care, testing the short and especially longer-term effects of brochures among CRC survivors may offer a more cost-effective approach than intense and resource demanding interventions that currently characterize the field.

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Figure 1.
CONSORT diagram

Table 1

Examples of gain and loss frame messages targeting TPB constructs

<u>TPB Construct</u>	<u>Gain frame</u>	<u>Loss frame</u>
Attitude	"Increase years of life"	"Decrease years of life"
Subjective norm	"Gain the approval of others who want you to do what you can to be in good health"	"Not gain the approval of others who want you to do what you can to be in good health"
Perceived behavioral control	"Gain peace of mind knowing you are doing what you can to keep yourself in good health"	"Lose peace of mind knowing you are not doing what you can to keep yourself in good health"

Table 2

Sample Baseline Demographic and Medical Information by Message Frame

Variable	Frame	
	Gain	Loss
Mean age (years)	64.3	65.4
Range	29.9–98.4	43.2–88.5
SD	12.1	11.1
Percent female	54%	50%
Percent Caucasian	83%	90%
Time since diagnosis (%)		
6 months to 1 year		
1 to 2 years	12%	7%
2 to 3 years	31%	37%
3 to 4 years	20%	23%
4 to 5 years	36%	33%
Cancer Site (%)		
Colon	51.3	50.0
Rectum	48.7	50.0
CRC stage (%)		
I	70%	79%
II	30%	21%
Education (%)		
Less than high school	1%	4%
Some high school/high school	23%	24%
Trade or technical school	8%	11%
Some college	23%	23%
College graduate	28%	19%
Graduate degree	8%	6%
Current smoker (%)	8%	6%

Table 3

Average Minutes of Total, Moderate and Strenuous Exercise at Baseline and Follow-up by Framing Condition

<u>Activity Level</u>	<u>Gain Frame Follow-up</u>				<u>Loss Frame Follow-up</u>				<u>p-values for change in</u>	
	<u>Baseline</u>	<u>1 Month</u>	<u>12 Month</u>	<u>Baseline</u>	<u>1 Month</u>	<u>12 Month</u>	<u>physical activity</u>	<u>Baseline to one month</u>	<u>Baseline to 12 months</u>	
Total (moderate + strenuous)	44.4 (67.5)	104.6 (129.7)	104.8 (136.8)	35.8 (40.7)	118.8 (149.0)	107.3 (174.4)		.39		.64
Strenuous	11.2 (31.1)	37.7 (75.1)	34.4 (70.1)	5.6 (19.0)	25.9 (49.7)	25.0 (50.6)		.50		.88
Moderate	33.2 (63.6)	66.9 (81.5)	70.4 (96.4)	30.1 (38.8)	92.9 (138.9)	82.3 (170.0)		.18		.50
Light	103.1 (114.8)	109.9 (148.1)	79.3 (135.1)	119.6 (178.3)	93.5 (115.6)	100.3 (133.7)		.27		.83

Note. P-value is associated with the test of the main effect for message framing. Values in parentheses represent the standard deviation.

Mean values of Theory of Planned Behavior Constructs at Baseline and Follow-up by Framing Condition

Table 4

TPB Construct	Gain Frame			Loss Frame			p-value
	Baseline	1-Month	12-Month	Baseline	1-Month	12-Month	
Subjective Norms	6.5 (0.74)	6.5 (0.81)	---	6.3 (1.04)	6.4 (1.05)	---	0.29
Perceived control	5.7 (.94)	5.8 (1.17)	---	5.9 (0.89)	5.8 (1.20)	---	0.38
Attitudes	5.7 (0.73)	5.8 (0.73)	---	5.6 (0.81)	5.9 (0.70)	---	0.66
Intention to exercise	5.8 (1.19)	6.0 (0.95)	5.8 (1.37)	5.6 (1.44)	6.0 (1.14)	5.7 (1.53)	0.33

Note. P-value is associated with the test of the main effect for message framing. Values in parentheses represent the standard deviation.