Published in final edited form as:
Am J Health Promot. 2007 ; 21(4): 255–261.

Health Belief Model Variables as Predictors of Progression in Stage of Mammography Adoption

Usha Menon, PhD, RN,
University of Illinois, College of Nursing, Chicago, Illinois

Victoria Champion, DNS, RN, FAAN,
Indiana University, Indianapolis, Indiana

Patrick O. Monahan, PhD,
Indiana University, Indianapolis, Indiana

Joanne Daggy, MS,
Indiana University, Indianapolis, Indiana

Siu Hui, PhD, and
Indiana University, Indianapolis, Indiana

Celette Sugg Skinner, PhD
Duke University Comprehensive Cancer Center, Durham, North Carolina

Abstract

Purpose—Identify predictors of change in mammography stage for nonadherent women so that appropriate stage-based interventions can be developed.

Design—Participants were randomly assigned to one of four groups in a randomized clinical trial to increase mammography screening. This report focuses on predictors of stages of change of mammography behavior; intervention results are reported elsewhere.[1]

Setting—Indigent clinic and health maintenance organization.

Subjects—Women, 50 or older, with no breast cancer diagnosis and nonadherent with mammography screening.

Intervention—The intervention and results are described elsewhere.'

Measures—Previously validated belief scales.

Results—Results showed that precontemplators and contemplators differed significantly at baseline and follow-up on all breast cancer beliefs except fear. Changes in barriers, benefits, and self-efficacy scores significantly predicted forward stage movement for women entering the study in precontemplation or contemplation (p = .0009, p= .037, and p= .048, respectively).

Conclusions—Changes in beliefs predict stage movement, and beliefs differ significantly among stages, hading the way for interventions tailored to both beliefs and stages of behavior adoption. In practical terms, we may be able to cut down on the "bulkiness" of our interventions and the number of tailoring variables, focusing more intensively on tailoring interventions to the beliefs whose changes have now been shown to predict stage advancement. These predictions are in addition to intervention effect which is reported elsewhere.[1]

Send reprint requests to Usha Menon, PhD, RN, University of Illinois-Chicago, College of Nursing, 845 S. Damen Avenue, MC 802, Chicago, IL 60612.

Keywords

Mammography; Breast Cancer; Tailored Intervention; Computer Based; Cancer Screening; Prevention Research

INTRODUCTION

Despite many recent advances in biomedical research, breast cancer remains the second-leading cause of cancer death among women in the United States.[2] Breast cancer screening has yet to reach optimal levels. Theorists believe that adopting a behavior such as having mammograms is usually a progression of distinct stages of change that may be cyclical in nature— i.e., an individual can move forward, regress, and then progress again. Theoretic frameworks that include stages of adopting a behavior may provide insight for promoting mammography. Many women have a mammogram but then regress to a nonadherent status by not being screened at the appropriate intervals. Therefore, although onetime use has increased, many women do not stay on schedule for routine screening[3] at intervals that will facilitate mortality reduction.

Our previous research determined that a woman's baseline stage of mammography adoption is an important predictor of mammography intervention effects.[4,5] That is, a mammography-promoting intervention may be differentially effective for women who, at the time of intervention receipt, are considering screening versus those who are not contemplating being screened. It is important to understand *both* actual mammography use and predictors of progression toward mammography behavior.

Purpose

The purpose of this article is to identify predictors (including changes in beliefs) of mammography stage progression in a longitudinal sample of women, with the longer-term goal of developing interventions tailored to both beliefs and an individual's stage of mammography adoption to promote mammography screening. The unique contribution of this article is that we assess longitudinally the extent to which *changes* in health beliefs predict stage progression. It should be noted that it is not the purpose of this report to assess effectiveness of the tailored interventions, which is reported elsewhere.[1] Results reported in the present article are for all women enrolled in the study.

Theoretic Framework

The Transtheoretical Model (TTM) can be used to conceptualize mammography behavior as a series of stages.[6] For mammography, the stages are [7]:

Precontemplation—Never had a mammogram; not planning on having one in next 6 months.

Contemplation—Never had a mammogram; planning on having one in next 6 months.

Action—Had a mammogram within the last 12 months. (Due to eligibility criteria, no women were in this stage at baseline.)

Relapse precontemplation—Prior mammogram but not currently adherent and not planning on having one in the next 6 months.

Relapse contemplation—Prior mammogram but not currently adherent and planning on having one in the next 6 months.

Maintenance—Adherent with mammograms for the past 2 years.

The primary difference between contemplators and precontemplators is that the latter do not intend to have a mammogram in the next 6 months while the former do indicate such intent. Those in relapse have had a prior mammogram but are no longer adherent with screening recommendations.[7] Definitions of stage must be adapted to the behavior of interest to be relevant. In using the above definitions of stage, we are following the lead of experts in the area of mammography screening, who operationalized the application of the TTM to mammography use.[7,8] By addressing stage of mammography behavior, we can design interventions—tailored to stage— to facilitate incremental changes in mammography screening behavior, with the ultimate goal of facilitating long-term mammography adoption and maintenance. For instance, how to move a woman from not thinking about having a mammogram (precontemplation) might take a different intervention approach than that needed for a woman who is already considering mammography (contemplation). To design effective stage-specific interventions, we must first understand which constructs predict movement in stage of mammography behavior.

Literature Review

Several studies have found differences in belief variables (found predictive of mammography in past research) and stage of mammography.[5, 9–11] Additionally, results of studies testing stages of change consistently suggest that stage-matched interventions may be more influential than standard education in increasing mammography use.[8,12–14] Based on these findings, many researchers have begun to target stage and health beliefs.

However, before we can really target interventions to stage, we must determine how change in beliefs predicts stage of mammography behavior as well as changes in mammography stage. Reports have indicated differences in perceived risks, perceived benefits, and perceived barriers by stage of mammography behavior, but a longitudinal assessment of whether *change* in beliefs predicts change in stage of mammography adoption is notably lacking. In this report, we will first describe differences in belief scores by stage of mammography adoption. Secondly, we will look at the ability of change in belief scores to predict forward movement in stage of mammography adoption. Perceived risk, benefits, and self-efficacy are expected to increase, and barriers are expected to decrease. In this article the baseline data collection is referred to as Time 1 and the 2-month follow-up collection as Time 2.

Hypothesis

We hypothesized that change in belief scores would predict forward movement in stage: precontemplators moving to either contemplation or action, or contemplators moving to action. A secondary research aim was to identify demographic predictors of forward movement in stage.

METHODS

The sample (N = 1245) was recruited from two different locations in the Midwest—from two health maintenance organizations (HMOs) in Indianapolis, Indiana, and a university-affiliated clinic for indigent patients in St. Louis, Missouri. This study was conducted with approval from the Indiana University and Washington University institutional review boards. Participants at the two sites significantly differed demographically with respect to

age, race, marital status, income, employment, and education (Table 1, $p < .0001$ for all demographic variables). Women in St. Louis were 83% African American and slightly older (mean age = 67) than women in the Indianapolis site with 58% over the age of 65. Women in St. Louis were more likely to report not being married or living with a partner (81%) and were economically disadvantaged—90% unemployed, 78% from households that made less than $15,000 annually.

Women at the Indianapolis site were HMO members; in contrast to the St. Louis population, the majority were white (76%), only 18% had less than a high school education, 70% made more than $15,000 annually, 41% were living with a partner, and 61% were younger than 65 years. Women at both sites were current patients or HMO members (i.e., seen within the past year in St. Louis or currently enrolled with one of the HMOs in Indianapolis).

Study procedures and interventions are described in detail elsewhere.[1,15] Women at both sites were eligible if they were 51 years of age, had no history of breast cancer, and had not had a mammogram in the 15 months prior to study enrollment. Women meeting these eligibility criteria were sent a letter and brochure explaining the study and contacted by telephone by a trained research assistant a week after the mailing. Participants were randomly assigned to either usual care or one of the three intervention groups. Four interviews were conducted—one at baseline and three postintervention. With institutional review board approval at both sites, verbal consent was obtained from the women. A total of 1245 women agreed to participate. The response rate at Indianapolis was 41% and in St. Louis 72%. This difference in response rate may be partly attributed to refusals to participate at the Indianapolis site due to busy schedules and lack of interest. It is also possible that those in St. Louis being of lower socioeconomic status and education may have been reluctant to refuse. Women who agreed to participate were interviewed immediately (Time 1), or an interview was scheduled for a more convenient time. After Time 1 was completed, women received one of the following, depending on random group assignment: (1) usual care (no intervention), (2) tailored telephone intervention, (3) tailored mail intervention, or (4) both tailored mail and telephone interventions. Four weeks following intervention a second interview was conducted (Time 2). Data reported here are from both Time 1 and Time 2.

Measures

Instruments used in this study were previously developed to measure the variables of perceived susceptibility, perceived benefits, perceived barriers, perceived self-efficacy, fear, and fatalism. Reliability and validity of these instruments were previously tested.[16] All belief scales, except fatalism, were measured on a five-point scale that ranged from Strongly Agree (5) to Strongly Disagree (1). For example, a barrier item read as follows: “Having a mammogram is embarrassing” with responses ranging from Strongly Agree to Strongly Disagree. The fatalism items were assessed by Yes/No responses. All individual item scores were summed in each scale to create a total scale score. Susceptibility is defined as a woman’s perceived risk of developing breast cancer, benefits are the positive outcomes associated with mammography, and barriers are the obstacles that prevent a woman from having a mammogram.[1,15,16] The fear scale comprised the emotional responses that a woman has when thinking about breast cancer,[17] where as fatalism is defined as the perception that death is inevitable after a cancer diagnosis.[18]

Tailored Interventions

The purpose of the tailored intervention was two-fold: (1) increase mammography use and forward stage movement postintervention and (2) promote a realistic risk perception, increase perceived benefits and self-efficacy for having a mammogram, increase knowledge

of the actual procedure, and decrease perceived barrier. Interventions comprised educational messages tailored to each woman's Time 1 responses to items measuring susceptibility, benefits, barriers, and self-efficacy. Messages relating to each possible response item for each question were developed for the intervention's "tailored message library." Algorithms in the tailoring program selected the combination of messages each woman received, based on her baseline questionnaire responses. For example, a woman whose baseline stage was contemplation received a message endorsing her intent to have a mammogram and encouraging her to take the next step and schedule an appointment.

Media used for delivery of the intervention varied by intervention group. Whereas those in the mail intervention group received their tailored messages in printed form, trained graduate research assistants delivered tailored messages over the telephone (tailored phone group) and engaged the women in an interactive session. Women in the combination group received the printed messages by mail, followed by the telephone intervention. The tailored messages are described elsewhere.[1] Samples appear in Appendix A. This report, however, focuses on predictors of mammography stage progression postintervention rather than effect of the intervention on mammography screening.

Statistical Analyses

To set the stage for hypothesis testing, we first examined differences in belief scores by stage of mammography adoption. Because belief scores were skewed, nonparametric tests were used to compare beliefs by stage cross-sectionally at Time 1 and Time 2. The Wilcoxon rank sum tested for differences in beliefs between precontemplators and contemplators at Time 1 (Table 2). All participants were nonadherent upon entry to the study. By Time 2, however, women were classified in one of three stages: precontemplation, contemplation, and action. To assess overall difference in beliefs among all three stages at Time 2, we used the Kruskal-Wallis test followed by pairwise comparisons using the Wilcoxon rank sum test (Table 3). To address the hypothesis that change in belief scores would predict forward stage movement, we used logistic regression. Regression models assessed whether change in beliefs was associated with forward movement in stage of mammography adoption (e.g., did/ did not advance to either contemplation or action by Time 2). For each of the belief scales, we ran a separate logistic regression model to predict advancement in stage (Table 4). To determine how the direction of change in beliefs affected stage movement, these models included the following categoric variables for change in beliefs: (1) increase in belief total scores, (2) no change, or (3) decline in belief total scores. Dummy variables were included, and contrasts performed, to use the models to compare *increase* versus no change, *decrease* versus no change, and increase versus decrease in belief scores. Other covariates included in all models were continuous age and intervention group (represented by three dummy variables). It should be noted that all groups (three interventions and a control group) were included in the analyses for this report. Although we refer to intervention group as a covariate in this paper, it is a very important variable and the primary predictor of interest in the main effectiveness paper published elsewhere. However, for the purpose of the present paper, the goal is to determine to what extent change in beliefs provide a prediction of forward stage movement on top of the prediction offered by intervention group. Age and intervention group were included in the multiple logistic regression models because they predicted stage advancement univariately at a p value less than .25 and remained significant at .05 in the final regression models for all beliefs. We liberally allowed covariates to enter the initial model because weak univariate association may display strong association when considered jointly with other covariates.[19] Baseline stage, race, and employment status were initially included in models because they were significant univariately ($p < .25$) but were deleted from the final models due to nonsignificance.

We were surprised that there was no significant interaction between baseline stage and change in belief for any of the belief scales ($p > .16$). Thus, although we originally intended to perform analyses separately for baseline precontemplators and contemplators, the lack of even marginal interactions implied that these two groups of women displayed similar relationships between change in beliefs and change in stage. Therefore, women in both baseline stages were combined into one analysis. An alpha of .05 was used for all tests. We did not adjust alpha for multiple comparisons because in this exploratory study, type II errors are more serious than type I errors. However, we report observed significance values in each table, and we report here the Bonferroni- adjusted alpha (.05/7 = .007), in which 7 is the number of beliefs in the "family" of comparisons.

RESULTS

Differences in Belief Scores Between Stages

At Time 1 we found differences in beliefs by stage of mammography adoption. Indeed, there was a highly significant difference between precontemplators and contemplators on all the belief scores at Time 1. Specifically, women in contemplation had higher perceived self-efficacy, benefits, fear, knowledge, and susceptibility, and lower perceived barriers and less fatalism (Table 2). There were also highly significant differences among stages of adherence at Time 2 for all beliefs except fear (Table 3, see Kruskal-Wallis *p* value). Women in precontemplation had lower scores for perceived self-efficacy, benefits, knowledge, and susceptibility, and higher scores for perceived barriers and fatalism compared with women in contemplation or action (Table 3, see *p* values from pairwise Wilcoxon Rank sum tests). The only difference between contemplators and those in action was higher perceived barriers among contemplators ($p = .0001$).

Association Between Change in Beliefs and Progression in Stage

A separate logistic regression model was performed for each belief (see Table 4). The dependent variable was change in stage; the modeled event of interest was forward stage movement (versus no change or backward movement). Change in barriers significantly predicted a forward movement in stage, after adjusting for age and intervention group ($p = .009$). Specifically, the logistic regression model estimated that the odds of forward stage movement for women who had an increase in perceived barriers, as compared with women demonstrating no change in barriers, was .56 ($p = .017$). Furthermore, the odds of forward stage movement for women demonstrating an increase in perceived barriers, compared with women who demonstrated a decrease in barriers, was .62 ($p = .0004$) (Table 4).

Change in benefits also significantly predicted forward stage movement ($p = .037$). Specifically, the odds of stage progression for women who had a decrease in perceived benefits, as compared with women demonstrating no change was .66 ($p = .024$). Furthermore, the odds of forward stage movement for women demonstrating an increase in perceived benefits, compared with women who demonstrated a decrease in benefits was 1.33 ($p = .039$) (Table 4).

Change in self-efficacy significandy predicted forward stage movement ($p = .048$). Specifically, women who showed a decrease in self-efficacy were less likely (odds ratio = .68) to move forward in stage, compared with women with no change in self-efficacy {p — .018). Changes in perceptions of susceptibility, fear, fatalism, and knowledge were not significantly associated with forward stage movement (Table 4).

DISCUSSION

Consistent with findings from previous studies, we found differences in belief scores across stages. In every case, mean between-group differences in beliefs existed, and these differences were in the expected direction (Table 2). At Time 1 women in precontemplation had significantly lower scores on perceived susceptibility, perceived benefits, self-efficacy, knowledge, and fear when compared with women in contemplation. The findings are not surprising; we would expect that women who are contemplating having a mammogram perceive themselves to be at risk for breast cancer, have the knowledge and confidence to obtain a mammogram, and perceive benefits of screening. Women in contemplation also had significantly lower barriers and cancer fatalism scores than women in precontempla-tion, again favoring screening behavior.

For Time 2 a substantial number of women in our sample had moved to action—allowing comparisons among precontemplators, contemplators, and actors (Table 3). As with Time 1, strong significant differences in beliefs emerged between groups. Women in precontemplation had lower beliefs for susceptibility, benefits, self efficacy, and knowledge compared with women in contemplation and action, who had higher scores. And again, precontemplators had higher barriers and fatalism scores than women in the contemplation or action stages. These findings are consistent with theoretic predictions of beliefs by stage.[6] It is interesting to note, however, that the greatest differences in mean scores for each belief were between precontemplators and women in the two other stages, whereas contemplators and actors tended to have similar scores except for barriers. This suggests that nonadherent women who are contemplating a mammogram are very similar in beliefs to those who have been screened within the recommended timeframe, except those in action have fewer perceived barriers. One exception was fear, in which precontemplators were slightly lower. Although there was very little difference among the three stage groups in fear, a certain level of fear may be necessary to motivate behavior; therefore, a lower level of fear for women in precontemplation is logical.

We had hypothesized that change in beliefs in the desired direction would predict movement forward to a better or higher stage of mammography adoption at Time 2 (postintervention). Our data (Table 4) suggest that no change or a decrease predicted forward stage movement. Additionally, no change in benefits (compared with a decrease) and an increase in benefits (compared with a decrease) were predictive of forward change movement. Finally, stability (no change) in self-efficacy (compared with a decrease) was a significant predictor of forward movement in stage of adoption. According to theoretic predictions, a half-standard deviation decrease in barriers should be sufficient to move an individual forward in stage.[6] Consistent with theory, the effects of increasing or maintaining stable belief in benefits (compared with a decrease) predict forward stage movement. Increasing fear (compared with no change in fear) also was marginally predictive. Explanations of the TTM indicate that not all beliefs will differ by stage, as supported by our findings (Table 3); the key is to identify *which* beliefs differ by stage. The present article contributes an important additional key element: to identify the beliefs whose *changes* predict stage *progression.*

Results from this study also support the supposition that changes in beliefs predict movement across stages. This finding is particularly important when interventions are being tailored to individual beliefs. Tailoring may need to be stratified by stage, so to speak, with more or less intensive interventions being delivered based on stage. Furthermore, tailoring could give priority to those beliefs whose changes are predictive of stage progression. Because we could not randomly assign changes in beliefs, our data indicate associations rather than causation. The relationship between beliefs and movement across stages is an important area for further research. This is especially true, given that the TTM and tailoring

health beliefs are increasingly used to guide behavioral interventions. Additionally, future research should also test which changes in particular item-level beliefs predict movement across stages.

Limitations

There are three main limitations of this study. First, as with all research studies, women who opted into the study may not be representative of a larger population. Secondly, the change in beliefs were associated with stage change and do not necessarily demonstrate a causal relationship. Finally, although reliability and validity of scales have been studied, the sensitivity of all instruments to demonstrate actual change in beliefs has not been tested.

In summary, our data support results of several studies that indicate that beliefs are different by stage of change.[5, 9–11] In turn, this brings us to a paramount question—did change in beliefs impact movement across stages? Our results indicate that changes in barriers, benefits, and self-efficacy significantly predict forward stage movement in the theoretically anticipated direction. In this respect, our results are the first to establish that changes in beliefs can predict forward movement in stage of adoption in mammography screening. In practical terms, this means we may be able to cut down on the "bulkiness" of our interventions and the number of tailoring variables, focusing instead more intensively on the beliefs whose changes predict advancement to the next stage. This would not only decrease the cost of interventions and reduce participant burden but may also be more effective in changing behavior.

Acknowledgments

This study was funded by the National Institute of Nursing Research RO1 NR 04081 01A1 and conducted with approval from the Indiana University Institutional Review Board and informed consent of participants. The authors gratefully acknowledge Roopa Seshadri, PhD, for her contribution to conception and design of this manuscript.

References

1. Champion VL, Skinner CS, Menon U, et al. Comparison of tailored mammography interventions at two months postintervention. Ann Behav Med 2002;24:211–218. [PubMed: 12173678]
2. Greenlee RT, Hill-Harmon MB, Murray T, Thun M. Cancer statistics, 2001. CA Cancer J Clin 2001;51:15–36. [PubMed: 11577478]
3. Centers for Disease Control and Prevention (CDC). Strategies for providing follow-up and treatment services in the National Breast and Cervical Cancer Early Detection Program—United States, 1997. MMWR Morb Mortal Wkly Rep 1998;47:215–218. [PubMed: 9551882]
4. Champion V, Huster G. Effect of interventions on stage of mammography adoption. J Behav Med 1995;18:169–187. [PubMed: 7563045]
5. Skinner CS, Arfken CL, Sykes RK. Knowledge, perceptions, and mammography stage of adoption among older urban women. AmJPrev Med 1998;14:54–63.
6. Prochaska, JO.; Redding, CA.; Evers, KE. The Transtheoretical Model and stages of change. In: Glanz, K.; Lewis, FM.; Rimer, BK., editors. Health Behavior and Health Education: Theory, Research and Practice. 3. San Francisco: Jossey-Bass; 2002. p. 99-120.
7. Rimer, BK. National consortium definitions of mammography stages of change. Personal communication. 2000.
8. Rakowski W, Ehrich B, Goldstein MG, et al. Increasing mammography among women aged 40–74 by use of a stage-matched, tailored intervention. Prev Med 1998;27:748–756. [PubMed: 9808807]
9. Lipkus IM, Rimer BK, Strigo TS. Relationships among objective and subjective risk for breast cancer and mammography stages of change. Cancer Epidemiol Biomarkers Prev 1996;5:1005–1011. [PubMed: 8959324]
10. Stoddard AM, Rimer BK, Lane D, et al. Underusers of mammogram screening: stage of adoption in five US subpopulations. Prev Med 1998;27:478–487. [PubMed: 9612839]

11. Skinner CS, Champion VL, Gonin R, Hanna M. Do perceived barriers and benefits vary by mammography stage? Psychol Health Med 1997;2:65–75.
12. Crane LA, Leakey TA, Rimer BK, et al. Effectiveness of a telephone outcall intervention to promote screening mammography among low-income women. Prev Med 1998;27:S39–S49. [PubMed: 9808823]
13. Champion VL, Ray D, Heilman DK, Springston JK. A tailored intervention for mammography in African-American women. J Psychosoc Oncol 2000;18:1–13.
14. Champion VL, Menon U, Maraj M, et al. Comparison of tailored interventions to increase mammography screening in nonadherent older women. Prev Med 2003;36:150–158. [PubMed: 12590989]
15. Skinner CS, Champion VL, Menon U, Seshadri R. Race and education differences in mammography-related perceptions among 1,336 non-adherent women. J Psychosoc Oncol 2001;20:1–17.
16. Champion VL. Revised susceptibility, benefits, and barriers scale for mammography screening. Res Nurs Health 1999;22:341–348. [PubMed: 10435551]
17. Champion VL, Skinner CS, Menon U, et al. A breast cancer fear scale: psychometric development. J Health Psychol 2004;9:769–778.
18. Powe BD. Fatalism among elderly Caucasians and African Americans. Oncol Nurs Forum 1995;22:1355–1359. [PubMed: 8539176]
19. Hosmer, DW.; Lemeshow, S. Applied Logistic Regression. 2. New York: Wiley; 2000.

Appendix A Sample Messages Tailored to Beliefs

Perceived susceptibility

A 58-year-old woman thinks she's too old for a mammogram.

Message

Risk of getting breast cancer increases with age. Since you are now 58, your chance of getting breast cancer is higher than when you were younger. What's more is that your risk will continue to increase as you get older.

Perceived benefit

A mammogram can find breast lumps early.

Message

Did you know that mammograms can find breast cancer about 2 years before it can even be felt by your doctor? Mammograms are the *only* way to find cancer this small. So instead of waiting for the cancer to grow until it can be felt, women can get early treatment and be on the road to recovery.

Perceived barrier

The woman is afraid to have a mammogram because it might show a problem.

Message

Have you put off having a mammogram because it might show a problem? Most women have normal results and that makes them feel good. If something is found, chances are it's not cancer. Even if it is cancer, if found early, chances for recovery are great. Either way, having a mammogram can reduce your worries.

Perceived self-efficacy

Low self-efficacy and doesn't know what to expect.

Message

If you have not had regular mammograms, you may feel hesitant and don't know about getting one. We all hesitate to do things that we have not had experience with, especially when we don't know what to expect. We can give you some hints to make this easier, including what to expect and how to set up a mammogram. The last two pages help you with these steps.

Stage-Contemplation

The woman never had a mammogram, and is thinking about having one in the next 6 months but does not have an appointment yet.

Message

Thinking about having a mammogram is the first big step. The second step is easy, call to make an appointment. We have included information about how to schedule a mammogram to help you take this next important step.

Table 1

Demographic Characteristics by Site

Demographic Variables		Indianapolis Mean (SD)	St. Louis Mean (SD)	Total Mean (SD)
Age*		63.7 (10.8)	67.4 (10.0)	65.7 (10.5)
		N (%)	N (%)	N
Race*	African American	123 (21%)	542 (82.5%)	665
	White	447 (76.4%)	100 (15.2%)	547
	Other	15 (2.6%)	15 (2.3%)	30
Marital status*	With partner	242 (41.4%)	123 (18.7%)	365
	Without partner	343 (58.6%)	535 (81.3%)	878
Income*	<$15,000	142 (24.4%)	498 (77.6%)	640
	$15,001–$30,000	192 (32.9%)	73 (11.4%)	265
	$30,001–50,000	121 (20.7%)	23 (3.6%)	144
	$50,001–$75,000	57 (9.8%)	2 (0.3%)	59
	>$75,000	40 (6.9%)	0 (0%)	40
	Don’t know	31 (5.3%)	46 (7.1%)	77
Employed*	Yes	293 (50.1%)	65 (9.9%)	358
	No	292 (49.9%)	592 (90.1%)	884
Education*	<High school	107(18.3%)	338 (51.7%)	445
	High school graduate	202 (34.5%)	178(27.2%)	380
	Some college	166(28.4%)	109 (16.7%)	275
	College graduate	49 (8.4%)	22 (3.3%)	71
	Graduate school	61 (10.4%)	7(1.1%)	68

*All p values <.0001.

Table 2

Difference in Time 1 Belief Scores by Stage at Time 1

Belief variables	Precontemplators (N = 311) Mean (± SD)	Contemplators (N = 933) Mean (± SD)	Wilcoxon Rank Sum p value
Barriers	38.4 (8.5)	30.4 (8.0)	<0.0001
Benefits	27.5 (4.7)	30.2 (3.8)	<0.0001
Susceptibility	5.7 (2.4)	6.4 (2.5)	<0.0001
Self-efficacy	40.9(6.1)	44.2 (4.9)	0.002
Fear	26.9 (9.4)	28.8 (9.6)	0.001
Fatalism	6.8 (4.0)	6.0(4.1)	<0.0001
Knowledge	3.2(1.7)	3.9(1.7)	<0.0001

Table 3

Difference in Time 2 Belief Scores by Stage at Time 2

Belief Variables	Precontemplators(N = 170) Mean (± SD)	Contemplators(N = 441) Mean (± SD)	Action(N = 433) Mean (± SD)	Kruskal-Wallis p value	Pairwise Comparisons*		
					P vs A	*CvsA*	*PvsC*
Barriers	37.8 (8.9)	30.1 (7.7)	28.3(8.1)	<0.0001	<0.0001	0.0001	<0.0001
Benefits	27.1 (4.8)	30.1 (4.0)	30.3 (4.0)	<0.0001	<0.0001	0.469	<0.0001
Susceptibility	5.6 (2.4)	6.2 (2.4)	6.3 (2.5)	0.0001	<0.0001	0.490	0.0002
Self-efficacy	41.1 (5.5)	43.9(5.1)	44.5 (4.8)	<0.0001	<0.0001	0.111	<0.0001
Fear	26.1 (9.6)	27.0 (9.3)	27.0 (9.4)	0.383	0.176	0.923	0.227
Fatalism	7.0 (4.3)	5.9 (4.0)	5.8(4.1)	0.005	0.002	0.610	0.005
Knowledge	3.5(1.6)	4.2(1.6)	4.0(1.6)	0.0002	0.002	0.159	<0.0001

* *p* value from Wilcoxon Rank Sum Test.

Table 4

The Effect of Change in Beliefs on Change in Stage, From Time 1 to Time 2, Using Binary Logistic Regression (N = 1044) Dependent variable = change in stage (increase in stage versus no increase in stage)

Belief	Change in Belief	Adjusted Odds Ratio	95% CI Lower	95% CI Upper	LRT *p* value	LRT *p* value
1 Barriers	Increase vs no change	0.56	0.34	0.90	0.017	0.0009
	Decrease vs no change	0.90	0.56	1.42	0.640	
	Increase vs decrease	0.62	0.48	0.81	0.0004	
2 Benefits	Increase vs no change	0.88	0.62	1.25	0.480	0.037
	Decrease vs no change	0.66	0.46	0.95	0.024	
	Increase vs decrease	1.33	1.01	1.75	0.039	
3 Susceptibility	Increase vs no change	0.92	0.68	1.24	0.573	0.471
	Decrease vs no change	1.11	0.82	1.50	0.490	
	Increase vs decrease	0.83	0.61	1.12	0.221	
4 Self-efficacy	Increase vs no change	0.89	0.66	1.21	0.469	0.048
	Decrease vs no change	0.68	0.49	0.94	0.018	
	Increase vs decrease	1.31	0.98	1.77	0.069	
5 Fear	Increase vs no change	1.54	0.97	2.49	0.069	0.189
	Decrease vs no change	1.41	0.89	2.24	0.141	
	Increase vs decrease	1.10	0.85	1.43	0.485	
6 Fatalism	Increase vs no change	1.17	0.82	1.66	0.392	0.674
	Decrease vs no change	1.14	0.81	1.62	0.447	
	Increase vs decrease	1.02	0.77	1.34	0.895	
7 Knowledge	Increase vs no change	0.99	0.74	1.33	0.957	0.860
	Decrease vs no change	1.08	0.78	1.49	0.657	
	Increase vs decrease	0.92	0.68	1.25	0.604	

Note: The confidence intervals (CI) are the profile-likelihood type, and the *p* values are from likelihood ratio tests (LRT). Covariates included in each model were continuous age and intervention group (represented by three dummy variables).