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Development of a Self-Efficacy Scale for Mammography

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Abstract: Mammography screening has been demonstrated to decrease mortality from breast cancer. Although adherence rates have increased, there is still a need to increase annual screening. Self-efficacy is a construct that has been found useful in predicting behaviors. Measurement of self-efficacy needs to be specific to the behavior and to have good validity and reliability. The purpose of this study is to describe development of a self-efficacy instrument to measure confidence in obtaining a mammogram. Bandura's model guided item development. Construct validity was measured using confirmatory factor analysis and logistic regression. Cronbach alpha was used to test internal consistency reliability. A Cronbach alpha coefficient of .87 was obtained. The mammography self-efficacy scale evidenced content and construct validity. © 2005 Wiley Periodicals, Inc. Res Nurs Health 28:329–336, 2005

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Regular mammography screening facilitates early stage diagnosis, which, in turn, contributes to mortality reduction. Almost 97% of women diagnosed with localized-stage breast cancer realize a 5-year survival, whereas those with distant disease have only a 20% chance of surviving 5 years (American Cancer Society, 2004). Although mammography adherence rates have increased substantially in the last 10 years, the most recent data from the National Health Interview Survey show that 35%–46% of women ages 40 or older have not had a mammogram in the last 2 years, and 60% report no mammogram in the last 12 months (American Cancer Society, 2001). New treatments are prolonging life, yet the greatest hope still lies in discovering breast cancer at an early stage when the disease is almost 95% curable. To date, the most effective weapon is annual mammography screening.

Several health beliefs such as perceived risks of breast cancer and perceived benefits and barriers to mammography and self-efficacy for mammography have been shown to predict mammography use (Champion & Skinner, 2003). Among these, self-efficacy is the least-studied; a reliable and valid measure of self-efficacy is notably lacking. Given that health beliefs, such as perceived benefits, barriers, and susceptibility, have explained only about 40% of the variance in mammography behavior, accurate measurement of additional explanatory constructs such as self-efficacy are important (Champion & Miller, 1996). The purpose

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of this study is to report psychometric data on a self-efficacy scale developed for mammography use.

The concept of self-efficacy is grounded in Bandura's social cognitive theory; it was originally defined as a judgment about personal capability (Bandura, 1986). In 1997 Bandura further developed the concept, emphasizing self-efficacy as the belief about individual ability to exercise control over a set of skills needed to complete a specific task.

A series of steps is required to have a mammogram. For instance, the first step may be to call and make an appointment. A self-efficacy belief related to this step would be the confidence a woman has in her ability to locate and contact a mammography screening center and schedule an appointment. A woman may have high self-efficacy for one step but low self-efficacy for another step. She may easily make an appointment, but overcoming fear of pain during the procedure will be more difficult. To gain the best predictive power, a self-efficacy measure should assess all steps in the behavior under study.

Bandura (1997) also describes self-efficacy as having several dimensions. First, self-efficacy beliefs may vary on level of difficulty according to the performance demands of a particular behavior. Running 1 mile might be considered doable in a time allotment of 15 minutes but would be very difficult in a time allotment of 8 minutes. Running an 8-minute mile would require a higher level of perceived self-efficacy. Second, self-efficacy encompasses the dimension of generality—whether people believe they are efficacious across many activities or only with limited behaviors. Individuals may believe that they can maintain dietary restrictions at home but not when dining out. Self-efficacy can be measured as behavior- and situation-specific or as a concept that crosses multiple behaviors or situations. Third, self-efficacy beliefs may vary in strength. People may have strong or weak beliefs about their ability to perform specific levels or steps related to the behavior of interest. Strength—the degree of certainty individuals have regarding their ability to complete the task—is measured by having participants assess, on a Likert-type scale, the degree to which they believe a certain statement is true. Validity is assessed by the degree to which the self-efficacy scale predicts the desired behavior.

Finally, Bandura (1997) identified four sources that build self-efficacy. The first is enactive mastery experience, defined as the history of performance relative to a behavior. Mastery experiences are not built solely on successes but also on failures that, with additional effort, can eventually be turned into success. Secondly, efficacy beliefs are built by vicarious experiences. Upon realizing that a friend with similar life experiences had no difficulty in getting a mammogram, a woman's confidence in her own ability might increase. Third, verbal persuasion and social influence can influence one's self-efficacy. A persuasive caregiver may be able to influence a woman's decisions. Fourth, physiological and affective states serve as feedback upon which persons judge their self-efficacy.

Research on the relationship of self-efficacy to breast cancer screening has been reported by several researchers with varying degrees of attention to measurement issues. One research group found a positive relationship between self-efficacy and breast self-examination (BSE; Friedman, Nelson, Webb, Hoffman, & Baer, 1994). Although the self-efficacy scale was composed of only two items, when added to a multiple regression model, self-efficacy was the strongest predictor of BSE behavior. In a study among Mexican American women, knowledge and self-efficacy were associated with both BSE and colorectal cancer screening (Carpenter & Colwell, 1995). A perceived self-efficacy measure for BSE also has been used to test outcomes of an educational program to increase BSE among Latina women, but the relationship of self-efficacy to actual BSE behavior was not explored (Mishra et al., 1998).

In a few studies, self-efficacy has been related to mammography behavior. Researchers used self-efficacy to predict intention to have a mammogram in a cross-sectional survey of 194 non-adherent women 52 years of age or older (Allen, Sorensen, Stoddard, Colditz, & Peterson, 1998). Self-efficacy was measured by a 2-item scale created for that study; items assessed degree of comfort (defined as self-efficacy) in discussing mammography screening with a health care provider and in being able to obtain a mammogram on a regular basis. These studies found self-efficacy strongly related to intent to have a mammogram.

Self-efficacy has been used by several researchers to predict other cancer screening behaviors. Findings of three studies show a positive association between fecal occult blood test (FOBT) and self-efficacy (DeVellis, Blalock, & Sandler, 1990; Hoogewerf, Hislop, Morrison, Burns, & Sizto, 1990; Myers et al., 1994; Vernon, Myers, & Tilley, 1997). However, Myers et al. and Hoogewerf et al. used only single items to assess self-efficacy. Vernon et al. reported that four items (originally assigned to the constructs of salience and coherence) loaded under a separate factor that they labeled self-efficacy. The four items focused on self-efficacy of screening overall rather than the behavior associated with each specific screening test, as recommended by Bandura (1997). The limitations of these instruments support the need to develop and test a scale to measure self-efficacy for mammography.

The purpose of this report is to describe development and psychometric testing of a scale developed specifically for measuring self-efficacy for obtaining a mammogram. Based on Bandura's theory (1997), our conceptual definition for this measure was perceived confidence in personal ability to obtain a mammogram. Hypotheses were as follows:

1. Cronbach alpha for the mammography self-efficacy scale will be above .70.
2. Test-retest reliability for the self-efficacy scale will be significant.
3. All items will have a correlation of .40 or greater on one dimension in confirmatory factor analysis.
4. The self-efficacy scale will show sensitivity to change over time.
5. Perceived self-efficacy will be related to mammography adherence.

METHODS

Item Selection

In developing the scale, we were guided by Bandura's outline of the three dimensions of self-efficacy (Bandura, 1997). First, to encompasses the dimension of generality, we developed items to measure perceived efficacy about a number of steps associated with the process of having a mammogram; these ranged from knowing how to obtain a mammogram, to getting transportation, to being able to talk with people at the mammography facility about concerns. Measuring efficacy for each and summing the scale score gives an overall measure of generality of perceived efficacy. Second, because self-efficacy beliefs may vary on magnitude according to the performance demands of a particular behavior, we included items assessing various parts of the mammography process that might be more or less difficult. For example, a woman might have high self-efficacy about calling to make an appointment, but have doubts about whether she can arrange for transportation to a mammography facility. Third, strength of the belief was measured by scoring items on a 5-item Likert-type scale ranging from *Strongly Agree* (5) to *Strongly Disagree* (1).

Twenty items were initially developed and submitted to five content experts: a psychometrician, a behavioral scientist working in breast cancer screening, two researchers who had used Bandura's theory extensively, and Dr. Bandura. Experts were asked to rate each as relevant or not relevant. Items were kept if they were endorsed by 80% of the expert reviewers. Experts were told that the item pool was expected to be unidimensional. We retained 10 items rated as relevant by 80%, or four of the five experts with the 10 items. All steps in the mammography process were included.

Reliability and Validity Testing

Reliability and validity were tested on a large multiethnic group of women who were part of a longitudinal intervention study to increase mammography screening. Internal consistency reliability was tested using Cronbach's alpha coefficient. The scale was developed to be unidimensional, thus validity was tested through confirmatory factor analysis. Further construct validity was tested by validating relationships of constructs based on Bandura's theory.

Sample

Participants were enrolled in a longitudinal intervention study to increase mammography use. We recruited 1,244 participants from two sites, a general medicine clinic setting serving predominately low-income clientele in St. Louis, MO, and another site which was comprised of middle-class women enrolled in one of two Health Maintenance Organizations (HMOs) in Indianapolis, IN. Eligibility included being 50–85 years of age, not having a mammogram in the last 15 months, and not having a history of breast cancer. Attrition from the primary study was 28%. Reasons for attrition included not able to recontact women, refusals to continue, and health reasons (Todora, Menon, Champion, Davis, & Skinner, 2001, unpublished). Drop out occurred at various points in the study. Compared to completers, those who dropped out of the study were more likely to report less education, lower incomes, and lower employment and were more likely to be African American, not married, and recruited from the general medicine clinic in St. Louis. Because of the 28% attrition, the sample size used in analysis of Time 3 data ($N = 905$) is smaller than the original sample ($N = 1{,}244$) recruited for the primary study.

Mean age of study participants was 66, $SD = 10.52$ (Table 1). A total of 51% had annual incomes of less than $15,000; 85% indicated that their physician or health professional had recommended mammography.

Following an initial letter and brochure describing the study, trained female research assistants contacted women and collected data via Computer Assisted Telephone Interviews (CATI). Women were randomly assigned to one of four study groups: (1) usual care, (2) tailored telephone communication, (3) tailored print communication, or (4) tailored print and telephone communication. Each data collection interview consisted of questions regarding beliefs derived from the Health Belief Model (HBM) and stage of mammography adoption. Women were interviewed at baseline (Time 1), 2 months (Time 2), 6 months (Time 3), and 12 months (Time 4) post intervention. Data for internal consistency and confirmatory factor analysis were obtained at T1. Test-retest analysis and sensitivity analysis used T1 and T2 data $N = 1{,}244$. The logistic regression analysis required the use of T3 data, $N = 905$, because that included the measure of mammography adherence.

Measures

Mammography adherence was assessed as self-reported date of last mammogram. All women were non-adherent at baseline (i.e., no reported mammogram in the 15 months prior to study enrollment). Women were categorized as adherent if they had a mammogram post-intervention.

Table 1. Characteristics of the Sample

	Total $N = 1{,}244$
Age	
65 and under	46%
66 and over	54%
Race	
African American	54%
Caucasian	44%
Other	2%
Education	
< High school	36%
High school	31%
> High school	33%
Employment	
Employed full time	20%
Employed part time	9%
Not employed	71%
Living status	
Currently married or living with partner	29%
No partner	71%

Data Analysis

The Statistical Package for the Social Sciences was used for all analyses except confirmatory factor analysis, for which we used Amos 4.0 (Arbuckle & Wothke, 1999). We began by conducting internal consistency reliability analysis and test-retest reliability. Test-retest reliability was calculated using Time 1 and Time 2 data, which were collected within a 1 month interval. Only subjects who did not have an intervention (e.g., members of the control group, $N = 283$) were used for test-retest reliability because the intervention could have affected self-efficacy beliefs.

Next we used confirmatory analysis to verify item fit with the latent variable of self-efficacy. Amos 4 was used to conduct a confirmatory factor analysis of the 10-item self-efficacy items on the latent variable of self-efficacy (Toit & Toit, 2001). Model fit was assessed by first examining the chi-square to degrees of freedom ratio as well as the Comparative Fit Index (CFI) and Normed Fit Index (NFI), Incremental fit Index (IFI), and Relative Fit Index (RFI). Ideally, these should be greater than .90. We also used the Hoelter Index to determine adequacy of sample size (Tabachnick & Fidell, 2001). After items were identified through confirmatory factor analysis, we tested hypotheses to verify theoretical relationships using binary logistic regression. Prior to analysis of mammography adherence, we tested demographic and experiential variables for relationships to self-efficacy using *t*-tests, Chi square or correlation as appropriate to level of measurement. Variables that were significant were then simultaneously entered into the logistic regression. Finally, we tested the total self-efficacy scale for sensitivity to change using a general linear modeling with repeated measures. Self-efficacy total scores were compared across Times 1, 2, and 3 by the adherent and non adherent group. The interaction term of time by group was used to assess significant change.

RESULTS

Internal Consistency Reliability and Test-Retest Reliability

A Cronbach alpha correlation coefficient of .87 was obtained for the total self-efficacy scale

Table 2. Reliability and Validity Testing for Self-Efficacy Scale

Item	Item Mean	Standard Deviation	Corrected Item/Total	Alpha if Item Deleted
You can arrange transportation to get a mammogram	4.29	.84	.52	.85
You can arrange other things in your life to have a mammogram	4.38	.75	.61	.84
You can talk to people at the mammogram center about your concerns.	4.28	.88	.52	.85
You can get a mammogram even if you are worried	4.40	.71	.69	.84
You can get a mammogram even if you don't know what to expect.	4.29	.88	.48	.85
You can find a way to pay for a mammogram	4.08	1.04	.44	.86
You can make an appointment for a mammogram	4.39	.75	.67	.84
You know for sure you can get a mammogram if you really want to	4.45	.68	.64	.84
You know how to go about getting a mammogram	4.33	.84	.57	.84
You can find a place to have a mammogram	4.42	.74	.64	.84

Overall alpha = .87; scale mean = 43.31; *SD* = 5.41; Skewness = (−.384); theoretical scale range = 5–50; actual range = 14–50.

(Table 2). Examination of the correlation matrix revealed all item correlations to be within .30–.70 as suggested by Ferketich (1991). Corrected item-total correlation coefficients ranged from .50 to .70, and were well within the acceptable range as prescribed by Nunnally and Bernstein (1994). Deletion of any individual item would have decreased internal consistency reliability. As indicated in Table 2, the overall scale mean is high with a skewed distribution. A skewed distribution is to be expected when items are correlated (Nunnally & Bernstein). Real test scores are rarely normal in distribution because items are correlated to form a scale. Test-retest reliability using Pearson correlation resulted in a coefficient of .52, $p < .001$.

Confirmatory Factor Analysis

As a measure of construct validity, we completed confirmatory factor analysis using a covariance matrix of scale items. First, model fit was assessed. The NFI, RFI, IFI, and CFI ranged from .98 to .99, all well above the cutoff of .90. Using the Hoelter Index, we determined that an adequate sample size would have been 151, thus we were well above the necessary sample size. The standardized regression weights, critical ratios, and probability are listed in Table 3. Regression weights for all items as shown in (see Table 3) were significant at the $p < .001$ level (Tabachnick & Fidell, 2001).

Testing of Theoretical Relationships

Bivariate analyses were completed with demographic variables to determine their relationship with self-efficacy and mammography adherence prior to entering variables into the logistic regression. *t*-tests were run for differences in self-efficacy by race (African American, Caucasian), physician's mammography recommendation (yes, no), and income. Income was divided into two categories with the first being annual incomes $\leq$ \$30,000 and the second being incomes $>$ \$30,000. Chi square was used to the test bivariate significance of race, mammography recommendation, and income with mammography adherence.

Those with higher income (χ^2 [4, $N = 893$] = 10.52, $p = .01$) and physician recommendation (χ^2 [2, $N = 898$] = 57.17, $p = .01$) were more likely to be adherent to mammography. Race was not related to mammography adherence. African Americans (t [881] = 5.71, $p < .01$) had higher self-efficacy scores, as did women who reported a physician's recommendation (t [900] = 3.43, $p > .01$). Income was not significantly

Table 3. Confirmatory Factor Analysis for Self-Efficacy Items

Item	Standardized Regression Weights	Critical Ratios
You can arrange transportation to get a mammogram	.50	15.97
You can arrange other things in your life to have a mammogram	.54	17.31
You can talk to people at the mammogram center about your concerns	.58	18.56
You can get a mammogram even if you are worried	.67	20.79
You can get a mammogram even if you don't know what to expect	.76	23.42
You can find a way to pay for a mammogram	.47	15.21
You can make an appointment for a mammogram	.74	23.31
You know for sure you can get a mammogram if you really want to	.68	21.69
You know how to go about getting a mammogram	.63	21.69
You can find a place to have a mammogram	.69	[a]

[a]Parameter.

related to self-efficacy scores. Physician recommendation, income, and race were significant in relation to either self-efficacy or mammography adherence; they were entered in the logistic regression with self-efficacy to control for their effects on adherence. All variables were entered simultaneously in one block.

For logistic regression, a model χ^2 (4, $N=$ 858) = 70.72, $p < .01$ (Table 4) was obtained. A beta of .089 ($SE = .016$) was obtained for self-efficacy. The effect size was significant and is reported as an odds ratio. Because the self-efficacy variable was a continuous measurement, the odds ratio cannot be interpreted is as normally done with a dichotomous value. The odds ratio for self-efficacy indicates that, for every point moved on the scale, a woman was 1.09 times more likely to obtain a mammogram. In other words, the higher the self-efficacy score, the more likely a woman was to receive a mammogram. Additionally, both income and physician's recommendation were significant; women with higher incomes were more likely to obtain a mammogram as compared to those with lower incomes, as were those who received a physician's recommendation as compared to those who did not receive a physician's recommendation.

Sensitivity to Change over Time

An important measure of scale validity is sensitivity to change over time; that is, being able to detect real changes in the construct that occur over time (Stewart & Archbold, 1992, 1993). To detect change over time, we conducted repeated measures using general linear modeling in which self-efficacy was compared across Times 1, 2, and 3 by mammography adherence status at Time 3. Theoretically, women who were adherent to mammography at Time 3 should have greater change in self-efficacy from baseline when compared to women who were non adherent at Time 3. Table 5 demonstrates the means in total self-efficacy scores at each of the three time points comparing women who were adherent and those who were not. The Time-by-Group interaction, which indicates differential change over time, was significant ($p < .001$). For the adherent group, total self-efficacy scores at Time 3 demonstrated

Table 4. Logistic Regression of Self-Efficacy, Income, Race, and Recommendation on Mammography Behavior

Variable	Beta	Standard Error	Odds Ratio	CI
Self-efficacy	.09	.014	1.09	(1.06, 1.22)
Income	.73	.16	2.07	(1.51, 2.84)
Race	.20	.16	1.22	(.89, 1.67)
Physician recommendation	.57	.84	1.77	(1.13, 2.76)

χ^2 (4, $N = 858$) = 70.72, $p \leq .01$.

Table 5. Change in Self-Efficacy over Time by Adherence

	Time 1 ($n = 905$)		Time 2 ($n = 905$)		Time 3 ($n = 905$)	
Group	Mean	*SD*	Mean	*SD*	Mean	*SD*
Adherent	43.77	.25	44.37	.24	45.35	.24
Nonadherent	42.98	.24	43.22	.24	43.30	.23

F (Time *Group; 2, $N = 860$) = 6.54, $p \leq .001$.

significantly more change in a positive direction than did the self-efficacy scores for the nonadherent group.

DISCUSSION

All five hypotheses in this study were supported. The self-efficacy scale had a Cronbach alpha of .87, indicating good internal consistency, and a test-retest reliability of .53. Test-retest reliability was significant although only a moderate correlation was evidenced. Moderate test-retest correlations often are found because just taking a test may sensitize an individual (reactivity) to an issue resulting in actual attitude change (Carmines & Zeller, 1991). The overall scale mean was high, reflecting the fact that the majority of this population had received a mammogram at some time in the past and was confident in the ability to be able to get a mammogram. As anticipated with a highly correlated and reliable scale, there was a negative skewness. However, the range was 14–50 and the standard deviation was 5.41, indicating adequate variability in the overall scale.

Confirmatory analysis yielded results indicating that all items were significantly correlated with the latent variable. Logistic regression results supported theoretical relationships in that women with higher self-efficacy were more likely to have had a mammogram post-intervention than women with lower self-efficacy. Theoretically, individuals with higher self-efficacy are more likely to indicate positive intention and actually perform behavior; this relationship was well supported by our findings.

Bivariate analyses of self-efficacy and demographic variables indicated that race, income, and physician's recommendation were significantly associated with self-efficacy; thus, these variables were entered into the logistic regression with self-efficacy to control for potential confounding effects on mammography adherence. When these variables were added simultaneously, race was not significant, leaving income and physician's recommendation as significantly related to adherence. Thus, income and physician's recommendation seem to be the important demographics in the effect of self-efficacy on mammography adherence for this sample. This does not, however, account for the fact that self-efficacy was higher in African American women than in Caucasian. If self-efficacy is higher in African American women and also predicts mammography adherence, the influence of additional variables that also may predict adherence in both races should be determined. These findings suggest that several variables work together to influence whether women are actually screened.

Among the strengths of this test of the self-efficacy measure is that it was tested with a combined sample of Caucasian and African American women. The measurement of self efficacy by a multi-item scale as opposed to prior work using only two items increases the accuracy of measurement and reduces error (Allen et al., 1998; Friedman et al., 1994). Instruments with limited items may not cover all the steps necessary to capture the construct as initially identified by Bandura (1997) Additionally, other research measured self-efficacy without consideration of the theoretical constructs (Allen et al.). The current scale developed all items to measure the theoretical attributes of self-efficacy as defined by Bandura (1997). Because our measure, in addition to having strong psychometric properties, also was related to mammography behavior in a combined sample, we encourage its continued use and testing with ethnically and socially diverse populations. According to Bandura (1997), a self-efficacy scale must measure individuals' beliefs about their ability to exercise control over the necessary skills needed to *complete* a task. A particular strength of our scale is that, in congruence with the theoretical definition proposed by Bandura, it measures the range of skills needed to obtain a mammogram.

While this scale shows promising results, several limitations must be acknowledged. First, self-efficacy and mammography adherence were collected at the same time, thus it cannot be assumed that the self-efficacy belief preceded mammography adherence. Secondly, the data were collected as part of a longitudinal intervention study that encouraged mammography adherence. It is possible that women who agreed to this study were more interested in obtaining mammography and thus a biased sample. Third, response bias and social desirability also may operate when questioning participants about a screening test that is so highly publicized. While these results indicate the importance of measuring self-efficacy when addressing mammography adherence, further work could address the limitations mentioned above. Use of this psychometrically sound instrument should improve the ability to identify women who are more likely to be adherent to mammography. It also may be useful in developing interventions to increase mammography behavior.

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