LONGITUDINAL PREDICTORS OF NON-ADHERENCE TO MAINTENANCE OF MAMMOGRAPHY

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Abstract

Background—Regular adherence to screening mammography, also known as maintenance of mammography, reduces breast cancer morbidity and mortality. However, mammography maintenance is uncommon, and little is know about why women do not maintain regular screening schedules. We investigated longitudinal predictors of women not maintaining adherence.

Methods—Participants were insured women enrolled in an intervention trial who had screening mammograms eight to nine months prior to study enrollment (*n*=1,493). Data were collected from 2003 to 2008. We used discrete event history analysis to model non-adherence to mammography maintenance over three successive annual screening intervals (+ 2 months).

Results—Most (54%) women did not maintain screening adherence over three years. Women who did not maintain adherence were more likely to be aged 40 to 49, rate their health fair or poor, be less satisfied with their last mammography experiences, report one or more barriers to getting mammograms, be less than completely confident about getting their next mammograms (lower self-efficacy), or have weaker behavioral intentions. The odds of not maintaining adherence decreased over time.

Discussion—While great strides have been achieved in increasing the proportion of women who have received mammograms, most women still are not maintaining regular mammography use over time. Our findings provide insights into targets for future mammography maintenance interventions.

Keywords

Mammography; breast cancer; maintenance; guideline adherence; health behavior

Introduction

Mammography maintenance, defined as having consecutive, on-schedule screening mammograms, is necessary for women to realize the full benefits of breast cancer screening (1–5). Annual mammography adherence has been recommended as an optimal screening interval to reduce breast cancer-related morbidity and mortality (1,6–9). However, it is not yet clear what effect the recent U.S. Preventive Services Task Force statement about biennial

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screening mammography will have on the guidelines of different organizations or practices of physicians and women (10). Whether one follows the annual guideline or an every two year guideline, non-adherence is a major issue (11). Only 38% of U.S. women report having received two consecutive screening mammograms on an approximately annual interval and 49% when using a biennial schedule (11). Mammography maintenance at annual intervals could reduce breast cancer deaths by 22% each year (12).

An extensive body of research on mammography use documents correlates of recent adherence (within the past one or two years) and repeat adherence (two consecutive screenings) (13–19). Identifying these correlates was important in developing interventions to encourage women to get mammograms, particularly in the early stages of diffusion, when most women had limited experience with screening mammography. Correlates of recent and repeat mammography adherence, however, may not be the same as correlates of mammography maintenance. Little is known about factors that help or hinder women from achieving mammography maintenance over time (20). Many previous studies of mammography used retrospective or cross-sectional study designs (13–17,21) that may have underestimated the effects of certain correlates, especially attitudinal factors (22). Other studies used intensive interventions (*e.g.*, telephone counseling) that may have affected these correlates (19,23–25) or followed women through only their next screening mammograms and, thus, provide limited information about predictors of mammography maintenance.

In the present study, we examined longitudinal predictors of non-adherence to mammography maintenance over three consecutive screening opportunities. We define non-adherence as not receiving consecutive mammograms on an annual schedule (+ 2 months). Choosing this approach allowed us to examine factors that inhibit repeated, on-schedule use in previously adherent women. Study participants were insured women who provide an important sample; they did not have the kinds of financial barriers that might inhibit maintenance of mammography use in the general population. For populations with health insurance and potentially fewer barriers to obtaining screening, beliefs and attitudes may play an especially important role in explaining why so many women do not maintain mammography screening adherence (26,27).

Methods

Participants

Data for these secondary analyses come from PRISM (Personally Relevant Information about Screening Mammography), a health communication intervention study whose methods are described in detail elsewhere (28). PRISM was a National Cancer Institute-funded intervention trial to enhance annual mammography adherence. It was conducted from October 2003 to September 2008 as part of the NIH Health Maintenance Consortium. The sampling frame for PRISM was female North Carolina residents, aged 40 to 75, who were enrolled in the North Carolina State Health Plan for Teachers and State Employees for two or more years prior to sampling.

To ensure uniform adherence to recent mammograms upon study entry, we invited women into the study who had screening mammograms eight to nine months prior to enrollment. We used health claims of mammography screening as the basis for this determination. Women who had more than one mammogram within this designated timeframe were ineligible, because these may have been diagnostic mammograms. Other exclusion criteria were having a personal history of breast cancer or not being able to speak or understand English.

Participants in analyses presented here are from the PRISM control group (*n* = 1,522). We chose this approach to avoid confounding that could have occurred by examining the research

questions among women who received intensive interventions. We further restricted the sample to exclude women who were not Non-Hispanic Black or White. The low numbers of women in other ethnic groups (*n* = 29) did not permit meaningful analysis. These decisions yielded a final analytic sample of 1,493 women. During the three years of the study, 37 women revoked consent and 12 died.

Procedures and Measures

Once enrolled in PRISM, women completed 30-minute baseline telephone interviews and then follow-up interviews at 12-, 24-, 36-, and 42-months after baseline surveys. Data for the present study are from interviews conducted at baseline, 12, 24, and 36 months, and health insurance claims data. We did not use the 42-month survey data because it only allowed six months beyond the last assessment at 36 months. Had we used these data, many women would not have been due to receive another screening mammogram within an annual interval (+2 months).

PRISM included an active control condition for ethical reasons, because numerous studies show that reminders are minimally effective in increasing mammography use compared to non-intervention controls (29). PRISM control group participants received mailed or automated telephone reminders that included dates of their last mammograms, information about mammography (such as recommended screening guidelines) and the contact number for the National Cancer Institute's Cancer Information Service. After delivery of reminders, PRISM intervention group participants who became off-schedule in any study year received supplemental interventions comprised of tailored priming letters and telephone counseling. The University of North Carolina and Duke University Medical Center institutional review boards approved study procedures.

Primary Outcome—While organizations differ on recommended intervals for screening, we adopted American Cancer Society guidelines in effect at the time of the study that recommend mammograms every 12 months for women aged 40 and over (7).Our main outcome was non-adherence to mammography maintenance, defined as <u>not</u> continuing to receive consecutive mammograms within annual screening intervals (+ 2 months) (*i.e.*, within 14 months). The 14-month boundary provides a two-month window for scheduling. Many mammography facilities have waiting queues for appointments, and it is customary to relax adherence definitions to allow for scheduling and other difficulties not under the control of the patient (11,30). All women entered PRISM with recent mammograms and were due for another mammogram two to three months after the baseline telephone interview. Thus, we modeled use over four interviews between which were three successive annual screening opportunities (+ 2 months).

We assessed mammography screening status through a combination of health insurance claims data and self-report data. At each annual survey, we asked women to confirm the claims data we had about both their most recent and prior mammograms. When women reported different answers than claims data indicated, we used self-report. Self-reports are valid measures of recent mammography use, especially for women in healthcare organizations and over short recall periods (31). If a woman could not be contacted in any year to confirm claims data, we used only claims data to assess adherence. For women who could not be reached to validate mammography dates, we used claims data only to calculate adherence in 8.7% (12-month survey), 12.2% (24-month survey), and 16.6% (36-month survey) of the cases.

Predictors—Variables of interest were selected from prior research on screening mammography and behavioral maintenance, with an emphasis on factors potentially amenable to change by intervention efforts or targeting specific subpopulations at risk for non-adherence.

Sociodemographic and medical variables: Telephone interviews assessed age, race/ethnicity, marital status, and education. Interviews also asked about perceived financial situation using a single item (25,31) that read, "*Without giving exact dollars, how would you describe your household's financial situation right now? Would you say that:* 0 = *after paying the bills, you still have enough money for special things that you want,* 1 = *you have enough money to pay the bills, but little spare money to buy extra or special things,* 2 = *you have money to pay the bills, but only because you have cut back on things,* 3 = *you are having difficulty paying the bills, no matter what you do.*" We dichotomized responses as *enough (money) for special things* or *little spare money*.

Telephone interviews included items about self-reported health status, doctor recommendations for mammograms in the last year, and family history of breast cancer (defined as having a biological sister or mother with a history of breast cancer).

Attitude and belief variables: These variables are from the Health Belief Model (32), Theory of Planned Behavior (33), and behavioral maintenance research. They were assessed at annual telephone interviews, using items adapted from previous studies.

Satisfaction with previous mammography use was measured with one item, *Thinking about the whole process of getting a mammogram, from making the appointment through getting your results, how satisfied or dissatisfied were you with your most recent mammogram?* (34) Due to low frequencies in one or more categories, we dichotomized responses as *very satisfied* or *somewhat satisfied/somewhat dissatisfied/very dissatisfied*.

Self-efficacy was assessed with one item, *How confident are you that you could get a mammogram when you are due?* (35) Due to low frequencies in one or more categories, we dichotomized responses as *very confident* or *somewhat/a little confident/not at all confident.*

We measured comparative perceived risk of breast cancer by asking participants, *How likely are you to get breast cancer in your lifetime compared to the average woman your age and race?* (36) Response options were *less likely to get breast cancer* (scored as 0), *about as likely to get breast cancer* (1) and *more likely* (2).

We measured behavioral intentions using the item, *How likely or unlikely is it that you will have a mammogram when you are due?* (37) We dichotomized responses based on prior research as *somewhat likely/somewhat/very unlikely* or *very likely*.

Decisional balance, a construct from the Transtheoretical Model (38), incorporates positive and negative attitudes toward mammography ("pros" and "cons"). Examples of survey items are *Having mammograms every year gives you a feeling of control over your health* (pro item), and *Once you have a couple of mammograms that are normal, you don't need any more for a few years* (con item) (39). Response options were *strongly agree, somewhat agree, somewhat disagree, strongly disagree*. Decisional balance was calculated by computing pros and cons scores and then subtracting the cons from the pros to compute a final score (range: −18 to 14). We used six items to compute the pros score and nine items for the cons score.

Perceived barriers to mammography were assessed through open- and closed-ended questions (40,41). First, participants were asked, *Has anything ever delayed your getting a mammogram? What was the main reason that delayed your getting a mammogram?* Women were queried up to three times to list any additional open-ended barriers. Next, participants were asked 10 closed-ended questions about what could delay their next mammograms. Response options were *strongly agree, somewhat agree, somewhat disagree, strongly disagree*. We considered barriers present if participants endorsed somewhat or strongly agree for any close-ended items. Two independent coders coded the open and closed-ended items and reconciled any

discrepancies. After eliminating duplicate barriers, we categorized women as reporting 0, 1, or 2+ barriers.

Data Analysis

We examined non-adherence to mammography maintenance over three consecutive screening opportunities using discrete event history analysis, a type of survival analysis (42,43). In discrete event history analysis, longitudinal models examine predictors of an event occurring or not occurring during specified units of time. First, participants' follow-up time is divided into discrete units (*e.g.*, a year) with an indicator of whether the event occurred or did not occur during that unit of time. Next, observations from each discrete interval are treated as distinct observations. Participants contribute observations to the dataset until they experience the event of interest, die, or withdraw from the study. These observations then are pooled into a stacked dataset. Finally, the binary outcome of the event occurring (or not occurring) is modeled using logistic regression (43).

In our study, the event of interest was mammography maintenance non-adherence, defined as not receiving consecutive screening mammograms within annual screening intervals (+ 2 months). Study follow-up time was divided into three 12-month intervals based on data collection and timeliness of next screening (*i.e.*, baseline to 12 months, 12 to 24 months, 24 to 36 months). Thus, units of assessment in this discrete event history analysis were person-years. Data were right-censored at time of event, death, withdrawal from the study or at the end of the last interval; 1,493 participants in our sample generated 3,428 person-year observations over three years of the study. Analyses allowed all attitude and belief variables to vary with time, meaning that we used values assessed at the baseline, 12-, and 24-month surveys as predictors of behavior in the subsequent period. Age, doctor recommendations for mammograms, and self-reported health status were allowed to vary over time as well. Other sociodemographic and medical variables were time invariant, meaning analyses used only the baseline values. We analyzed data with SAS 9.1 statistical software (SAS Institute Inc., Cary, NC).

Results

Participant characteristics

Most women were aged 50 and over, non-Hispanic white, married or living as married, had obtained a college degree or more education, said they had a usual source of medical care, and reported at least good health status (Table 1). The majority of women lived with only one other person and reported a financial situation that allowed them to "buy special things." About 17% of women reported a family history of breast cancer. Most women reported favorable attitudes and beliefs toward obtaining mammograms and perceived their risk of breast cancer to be about as likely to occur for them as for other women their age and race. Almost half the women reported two or more barriers to getting their next mammograms when due.

Just over half the sample (54%) did not maintain adherence to screening mammograms; 26% (*n* = 392) did not maintain adherence at the end of the first interval. At interval two, an additional 16% (*n* = 243) were not adherent and, in the last interval, another 11% (*n* = 171) were not adherent.

Predictors of Mammography Maintenance Non-adherence

Women in their forties were more likely than women aged 50 and over to not sustain mammography adherence (*p*<0.001), as were women who rated their health as fair or poor when compared to women with self-rated good or excellent health (*p*<0.001). (Table 2) Non-adherence to mammography maintenance was more likely for women who were less satisfied

with their last mammography experiences (*p*=0.013), reported one (*p*=0.018) or more (*p*<0.001) barriers to getting mammograms, were less than completely confident about getting their next mammograms (lower self-efficacy) (*p*=0.041), or had weaker behavioral intentions (*p*<0.001). Likelihood of experiencing mammography non-adherence decreased over time (*p*=0.003). All other variables were in the expected direction but not statistically significant (*p*>.05).

Discussion

As use of mammography has increased in the U.S., the focus of breast cancer screening has expanded from getting women to initiate mammography screening to encouraging them to maintain use over time. Despite this focus, few studies have examined mammography maintenance. We examined theoretically and empirically informed predictors of mammography maintenance non-adherence, defined as not receiving successive annual (+ 2 months) screening mammograms, in a population-based sample of insured women over three consecutive screening opportunities.

Because women in our sample had received mammograms eight to nine months before entering the study and were then followed for three years, we ascertained participants' mammography maintenance profiles over three annual screening cycles. Most studies to date have assessed only recent or repeat use or used biennial screening intervals. We used a novel approach, discrete event history analysis, to address our research aims. This method can account for interdependence of data, assess the effect of time on maintenance of mammography, is well-suited to handle attrition (because participants are censored at the time of withdrawal), and can accommodate a large number of time-varying covariates. Use of longitudinal models that account for multiple assessments of both predictors and the outcome may be particularly helpful for intervention planning. These models more carefully establish the temporal ordering of predictor and outcome.

Over half the women in this study did not sustain maintenance of screening mammography over the study period. The rate of mammography maintenance we report here is similar to rates reported in two previous studies of mammography adherence that examined screening behavior across three or more screening cycles (range: 42 – 56%) (20,30). However, we expected more women to maintain mammography screening, due to unique characteristics of this sample. Almost all women reported a usual source of medical care, had health insurance, were recent users of mammography (eight to nine months before study entry), maintained relatively favorable attitudes and beliefs towards mammography use over the course of the study and, as part of PRISM, received annual mammography reminders. In addition, the sample was similar on many sociodemographic characteristics associated with mammography use (*e.g.*, higher income, college-educated, insured) (20,21,44). Overall, it was a group that should have been especially likely to receive continued mammograms. The modest maintenance rate may reflect, in part, our analyses that used an approximately annual screening interval (although with a 14-month window), a criterion that yields fewer adherent women than does the use of longer intervals (30,45). Yet, the odds of not getting screening mammograms decreased over time. It appears that as women obtain more on-schedule mammograms, they are more likely to overcome challenges to getting mammograms. Thus, past behavior continues to be a strong predictor of future mammography adherence, as others have found (46).

Several attitude and belief variables predicted adherence. Reporting one or more barriers to mammography predicted non-adherence to maintenance. Although consistent with much of the previous research on mammography use (47,48), this finding extends results to longer-term outcomes. Not surprisingly, women who reported multiple barriers to obtaining mammograms seem to have more difficulty getting them. Future studies may want to explore the role of

specific barriers (*e.g.*, financial, logistics, competing priorities) on women's ability to maintain regular mammography screening schedules. Although previous studies have examined some of these barriers, they do not answer questions about maintenance of mammography over time.

We also found that lower self-efficacy and weaker behavioral intentions may play a key role in explaining why some women are unable to maintain regular screening schedules. Previous research has shown that self-efficacy is an important variable in behavioral maintenance across a variety of health behaviors (49–51). Self-efficacy may be particularly central in moving women from thinking about getting mammograms to actually obtaining them (50,52). In the context of mammography maintenance, strong intentions may serve as a motivating force that prompts planning, as supported by the role intentions play in maintenance of daily behaviors (53). Planning may buffer against challenges women experience when trying to maintain behavior change.

As previous studies have found, women who were more satisfied with their mammography experiences were more likely to return for future mammograms (54,55). Our results support these findings and offer evidence that satisfaction may also be an important factor in explaining long-term behavior maintenance. Unfortunately, we did not explore specific domains of women's satisfaction with their past mammography experiences. If confirmed in other research, understanding the underlying experiences and beliefs that lead to greater satisfaction with screening experiences may be essential in promoting mammography maintenance.

Of the remaining cognitive variables, perceived susceptibility to breast cancer and attitude towards use did not predict mammography maintenance, although they have been predictors of repeat use in other studies (20). Risk perceptions (44) and attitudes towards the behavior (20,56) may be necessary components of why people contemplate initiating a behavior but may not be motivational influences maintenance.

Only one sociodemographic variable, younger age, predicted maintenance non-adherence. Previous studies of mammography use support age as an important factor in screening behavior (16,25). However, past mammography research has demonstrated relationships between mammography adherence and many of the sociodemographic factors tested here, such as income (21), race (57) and education (14). Our findings of no association may follow from the wide dissemination of mammography screening over the last 20 years; more frequent use may have equalized some disparities reported in earlier mammography research. For example, recent studies using national data have not found disparities between black and white racial groups and mammography use (15,58,59). Our null findings also may reflect the relative demographic homogeneity of the study sample or the equalizing effect of having health insurance.

Of medical history and healthcare variables assessed in our study, only self-reported worse health status predicted non-adherence to maintenance of mammography screening. Poorer health status has been associated with not engaging in other health behaviors, including mammography screening (21,60). Early detection behaviors, such as regular mammography use, may not be a priority for women with competing health issues. Moreover, doctors may not recommend mammograms for women with some competing health concerns. While receiving a doctor's recommendation was a strong predictor of use in previous studies (13, 14,61), this was not the case in our study. In order to sustain use over time, women may need additional supports beyond encouragement from their providers. This null finding also may reflect the relatively high access to medical care for women in our sample.

Our results should be interpreted with some caveats. Findings are from a population that had health insurance, was predominantly non-Hispanic white, reported a usual source of medical care and, as part of the study, received annual mammography reminders. Women also entered

the study adherent, having received mammograms eight to nine months prior to baseline surveys. Generalizing our findings beyond these groups should be done cautiously. Also, our results may be specific to maintenance when defined as annual mammography screening and may not apply to biennial screening. Nevertheless, we believe it likely that at least some of the variables we identified here will apply regardless of whether the schedule is annual or biennial. Also, our study allowed us to assess predictors of mammography maintenance only as a dichotomous outcome (maintained vs. did not maintain use). We were not able to assess predictors of other use patterns, such as sporadic or lapsed screeners who then received a subsequent screening. Last, while the longitudinal design is a primary strength, it does not allow us to infer causality.

Our research also has several strengths. Our study is one of only a handful to assess simultaneously, attitudinal, healthcare, and sociodemographic variables as predictors of longer-term mammography adherence. Also, we used claims data confirmed by annual self-reports to assess intervals between screening mammograms, instead of viewing only a general pattern of screening across three years. Accurate assessment of mammography use is a growing concern for researchers. Study findings can differ greatly according to how their outcomes are operationalized (21,30). The sample also included women in their forties, an understudied group, especially in annual-interval mammography adherence research.

Conclusions

Health behavior researchers have focused more often on promoting behavior change than on sustaining these changes, especially for periodic screening behaviors such as mammography use. While most women in the U.S. have had prior mammograms (15), our study provides additional evidence that we have not yet achieved optimal levels of adherence to mammography maintenance. This is an especially striking finding in an insured, previously adherent sample. We identified factors that other studies have shown predict short-term use, such as intentions, barriers, and self-efficacy, along with other factors that influence maintenance of daily behaviors, such as satisfaction with past experiences. These variables also were important in explaining maintenance of mammography screening over time. Our analyses provide insights into potential targets for future mammography maintenance interventions. If clinicians and patient educators are to design effective programs to increase the numbers of women receiving regular, on-schedule, mammography screening for many decades after they turn forty, future research should continue to search for factors that can provide the basis for these intervention programs or study specific groups of women most in need of extra attention.

Acknowledgments

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Table 1

Characteristics of study participants (*n* = 1,493)

Characteristic	Frequency	% or mean (SD)
Age		
40–49 years	303	20.3
50–75 years	1190	79.7
Race		
Non-Hispanic white	1342	89.9
Education		
Grade 12 or less	239	16.0
Some college	326	21.8
College degree	928	62.2
Married/living as married	1201	80.6
Additional members living in the household:		
0	162	10.9
1	786	52.7
2	292	19.6
3+	253	17.0
Perceived financial situation as "enough for special things"	924	62.3
Self-reported health, "excellent" or "good"	1342	90.1
Family history of breast cancer	244	16.5
Had a usual source of medical care	1445	96.8
Doctor recommendation for a mammogram in past year	1161	77.9
Perceived satisfaction, "very satisfied" with previous mammography experience	1326	88.9
Number of perceived barriers		
No barriers	381	25.5
1 barrier	379	25.4
2+ barriers	733	49.1
Self-efficacy, "very confident" in getting a mammogram when due	1386	93.0
Attitude towards mammography as measured by decisional balance score		8.2(3.1)
Comparative perceived risk of getting breast cancer		
Less likely	381	26.7
About as likely	826	57.8
More likely	222	15.5
Intentions, "very likely" to get mammogram when due	1370	91.8
Mammography maintenance non-adherence	806	54.0
Number of non-adherent women per interval		
Baseline to 12 months	392	26.3
12 to 24 months	243	16.3
24 to 36 months	171	11.5

Table 2

Predictors of mammography maintenance decay

	Odds Ratio	95% CI
Age[*]		
40–49 years	1.66[†]	1.33–2.06
50+ years	reference	
Race/Ethnicity		
Non-Hispanic black	0.99	0.72–1.35
Non-Hispanic white	reference	
Education		
Grade 12 or less	0.93	0.72–1.20
Some college	1.13	0.91–1.41
College degree or more	reference	
Marital Status		
Unmarried/widowed	1.17	0.94–1.46
Married/living as married	reference	
Perceived financial situation		
Little spare money	1.14	0.45–1.38
Enough for special things	reference	
Health status[*]		
Fair or Poor	1.68[†]	1.27–2.23
Excellent or Good	reference	
Family history of breast cancer		
Yes	reference	
No	1.10	0.84–1.44
Doctor recommendation for a mammogram in past year[*]		
Yes	reference	
No	0.97	0.80–1.18
Satisfaction with previous mammography experience[*]		
Very satisfied	reference	
Somewhat satisfied/dissatisfied or very dissatisfied	1.43[†]	1.08–1.90
Number of perceived barriers[*]		
No barriers	reference	
1 barrier	1.35[†]	1.05–1.73
2+ barriers	1.48[†]	1.18–1.86
Self-efficacy in getting a mammogram when due[*]		
Very confident	reference	
Somewhat/a little/not at all confident	1.48[†]	1.02–2.17
Attitude towards mammography as measured by decisional balance score[*]	1.01	0.98–1.05

	Odds Ratio	95% CI
Comparative perceived risk of getting breast cancer[*]		
Less likely	1.03	0.75–1.41
About as likely	0.93	0.70–1.22
More likely	reference	
Intentions to get a mammogram when due[*]		
Very likely	reference	---
Somewhat likely, somewhat unlikely or very unlikely	2.66[†]	1.84–3.84
Years adherent to mammography	0.84[†]	0.75–0.95

Note. Results of discrete event history analyses are based on data from 1,493 participants and 3,428 person-years. Analysis included all variables in the table. Odds ratios greater than 1.0 indicate an increased likelihood of maintenance non-adherence.

[*] Time-varying covariates

[†] *p-value* < 0.05