Relationships among Objective and Subjective Risk for Breast Cancer and Mammography Stages of Change1

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Abstract
This study examined the relationships among objective and subjective risk for breast cancer and mammography stages of change as defined by the Transtheoretical Model. Women who had higher objective risk of breast cancer, as defined by the Gail et al. algorithm (M. H. Gail et al., J. Natl. Cancer Inst., 81: 1879–1886, 1989), were more likely to perceive themselves at greater subjective risk for breast cancer. Among the components of objective risk, family history of breast cancer was the only significant predictor of subjective risk. Both objective and subjective risk individually predicted stages of change, such that higher objective and subjective risk were associated with an increased probability of being in a later stage of adopting mammography. However, when objective and subjective risk were included in a multivariate model, only subjective risk predicted stages of change. In additional multivariate analyses, subjective risk continued to predict mammography stages of change when “con” and “decisional balance” scores were included in separate models. These results suggest that future research may benefit from the explicit integration of personal risk perceptions with elements of the Transtheoretical Model to provide more powerful accounts of behavioral change processes.

Introduction
Risk perceptions have played an important role in many models of health behavior, such as the Health Belief Model (1), the Protection Motivation Theory (2), and the PAM (3). These models hypothesize that heightened feelings of vulnerability facilitate many preventive health and detection practices, including mammography screening (4).

Although increased perceptions of risk do appear to play a mediating role in promoting mammography screening in general, there is little information concerning how objective risk factors affect subjective risk and subsequent screening (5–7). Such information is necessary for several reasons (5). For example, interventionists need to understand how the intended audience perceives its level of risk to correct misconceptions that can deter appropriate screening behavior. Thus, an important component of promoting informed decision-making about breast cancer screening is enhancing the accuracy of perceived risk. Unfortunately, women often incorrectly assess their level of risk (6, 8), even when attempts are made to correct these miscalculations (9). Indeed, the correlation between a woman’s objective risk and her perceived risk has hovered around a modest 0.20 (10).

The purpose of this preliminary report was 3-fold. The first objective was to examine the relationship between objective and subjective risk indices and screening patterns among women age 50 and older who are members of a health maintenance organization. As a part of this, we attempted to partially replicate the findings of Aiken et al. (5), who assessed women’s attributions of risk for breast cancer. Attritions were coded into six categories following the scheme developed by Weinstein (11): personal actions (e.g., diet and exercise); heredity (e.g., family history); physiology (e.g., medical history, breast feeding, and having children); environment (e.g., pesticides); psychology (e.g., stress and personality); and chance. Aiken et al. found that the two most common contributors to perceived risk were personal actions and heredity. Women who viewed themselves at below-average risk mentioned personal actions more frequently as a risk-decreasing than -increasing factor; similarly, heredity was mentioned more frequently as a risk-decreasing than -increasing factor; that is, women felt they were at less risk for breast cancer if they did not have a family history of the disease. Moreover, they found that subjective risk estimates were correlated positively with several objective risk measures (e.g., family history, having a lump, and others). Thus, consistent with Aiken et al. (5) and others (7), we expected that overall objective risk, here assessed by the Gail et al. (12) model, would be a positive predictor of subjective risk. However, given that most women acknowledge family history as the most salient feature of objective risk (13), we predicted that this factor, rather than the number of biopsies, age at menarche, and age at first live birth [other important contributors of risk according to the Gail et al. (12) model] would be the most powerful predictor of subjective risk.

The second goal was to test whether objective and subjective risk would predict mammography stages of change as defined by the TTM (14, 15). This represents a novel contribution to the literature. Unlike other health behavior models, the TTM does not place an emphasis, although it does not discount the importance, of personal risk perceptions in promoting movement among stages. Perceived risk can be accommodated within the TTM framework by viewing risk as a consciousness-raising experience. That is, enhancing the saliency of one’s risk of breast cancer (i.e., consciousness-raising)
may be viewed as a strategy, or process of change, that can help promote mammography screening. Consciousness-raising, as a process of change, seems to be useful in modifying behavior during the initial stages of change (e.g., precontemplation and especially contemplation; Ref. 15).

Enhancing the saliency of one’s risk for breast cancer as a method of consciousness-raising should be especially important in promoting change among women in the initial stages of change (e.g., precontemplation and contemplation), although it should remain an important factor in maintaining screening. The notion that risk perceptions play a prominent role early in the behavior modification process is consistent with another stage-based model of behavior change, the PAM (3). According to the PAM, individuals must assume first that a particular hazard poses a threat to others and then to themselves before the intention to adopt and change their behavior occurs. Importantly, the model suggests that once a person accepts being at risk, this heightened perception helps to sustain the behavioral change. Hence, mapping the stages proposed by the PAM onto the TTM suggests that there should be variability in perceived risk among stages, such that individuals in the “earlier” stages (e.g., precontemplators and contemplators) should have lower perceived risk than individuals in the “later” stages (e.g., action and maintenance).4

The third goal was to determine whether objective and subjective risk would predict mammography stages of change in addition to decisional balance. According to the TTM (14, 15), movement along stages of change is mediated not only by strategies of change, but also by an individual’s perceptions of the “pros” (benefits), “cons” (disadvantages), and “decisional balance” (overall weighing of the pros and cons). In general, higher pro and decisional balance scores and lower con scores have been associated with the initiation and maintenance of mammography screening, i.e., being in the action and maintenance stages (16, 17). If objective and subjective risk uniquely predict mammography stages of change, these results would provide strong suggestive evidence that risk should be integrated explicitly with elements of the TTM to provide a more powerful account of behavioral change processes.

Subjects and Methods

Study Population. These data are derived from two sources. The first stems from baseline telephone interviews conducted as part of a 5-year study to assess the impact of barrier-specific telephone counseling or written barrier-specific tailored messages on adherence to regular breast cancer screening. This research is being conducted as part of the Breast Cancer Screening Consortium of the National Cancer Institute.

The original sampling frame was provided by the Kaiser Foundation Health Plan of North Carolina in the Research Triangle area. On the basis of medical records, only women ≥50 years of age who had received two or fewer mammograms in a 36-month period (May 1991–May 1994) were considered eligible for the study. Overall, 1913 women were eligible and contacted to provide written informed consent. The 638 women who provided written consent prior to February 1995 were contacted by a professional survey organization, Mathematica Policy Research, to conduct a 20-min baseline telephone interview that assessed demographic characteristics, screening history, and several psychosocial variables related to mammography. Of the 638, 77 were no longer eligible because they had cognitive, emotional, and/or physical impairments; had breast cancer; or were no longer members of Kaiser. In all, 561 women were eligible to participate; of these, 75 could not be contacted. Thus, 486 women completed the baseline interview, resulting in a response rate of 87% out of the original 638.

These 486 women were recontacted an average of 3 months later to update their mammography screening history, assess barriers to screening, and measure a few more psychosocial variables related to mammography. This constituted the second source of data. Of the 486 eligible participants, 22 were dropped from the study due to death, health problems, ceasing of membership in the Kaiser Foundation Health Plan, and refusal to participate (n = 2).

For the present study, eligible participants were the 364 women who, in addition to having data on screening history, pros and cons of mammography screening, and objective risk, provided a response to their subjective risk of either below average, average, or above average. Women who stated they did not know their subjective risk of breast cancer were dropped from the present analyses; thus, perceived risk was the main criterion for inclusion in this study. Women who provided a “don’t know” response to their subjective risk did not differ on education or objective risk compared to women who provided a risk estimate of below average, average, or above average. However, women who did not know their subjective risk were significantly older than women who did provide an estimate of their subjective risk (M = 60.89 versus M = 58.45; t = 2.87; P < 0.005).

The average age of the population of 364 women was 58.4 years (SD, 6.9). Eighty-three percent (n = 254) were white, 83.2% (n = 303) were married, and 60.4% (n = 220) had some college education or more. None of these demographic variables appreciably affected any of the results and will not be discussed further. The relevant measures are described below.

Objective Risk. Components of objective risk were collected and assessed during the baseline phone survey using the Gail et al. (12) algorithm. This entailed, in addition to age, asking women how many breast biopsies they had, age at menarche, age at first live birth, and number of relatives with breast cancer (mother or sister only). The mean lifetime risk was 11.2% (SD, 0.04; range, 6.6–32.6%). As an additional measure of objective risk, we also asked women whether they ever had any breast problems (response, yes or no).

Decisional Balance. The pros and cons were assessed at baseline by 5 and 14 items, respectively, adapted from work by Rakowski et al. (see Appendix; Refs. 16 and 17). For each statement, participants were asked whether they agreed, disagreed, or were undecided. All “agree” responses received a score of 1, “undecided” a score of 0, and “disagree” a score of −1. Thus, higher positive scores on the pro scale represented more favorable attitudes toward mammography, and a higher negative score on the con scale represented more favorable attitudes toward mammography (i.e., these women disagreed more with the con statements about mammography). Overall decisional balance was measured by subtracting the con from the pro scores. Therefore, a higher positive score reflected more favorable beliefs about mammography. Cronbach’s α in this population was 0.73 and 0.75 for the

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4 For ease of presentation, we discuss women as being in the early (least likely to have engaged in the behavior) or later stages (having engaged with the intent of continuing to perform behavior). We do not wish to imply that stages should be treated as continuous variables.
pro and con scales, respectively, resembling the findings by Rakowski et al.6

Perceptions and Attritions of Subjective Risk. Subjective risk was assessed during the second survey by asking women what they thought their chances were of getting breast cancer within the next 10 years compared to other women their age. Response options were below average, average, and above average. After providing a risk estimate, women were asked why they rated their level of risk as they did. Responses were categorized by two coders into one of the categories used by Aiken et al. (5) based on Weinstein’s (11) scheme: personal actions, heredity, physiological, environmental, psychological, chance, and other. Initial coder agreement was 91%. All discrepancies were discussed until consensus was reached.

Stages of Change. Mammography stage of change was assessed during the second phone interview and, as recommended by Rakowski et al. (16, 17), took into consideration previous screening behavior and the intention to have another mammogram within the next year. Based on these items, women were placed into the following defined categories: (a) precontemplators (n = 8): never had a mammogram and do not intend to have one in the following year; (b) relapse (n = 33): have not had a mammogram within the last year and do not intend to have it in the following year; (c) relapse risk (n = 29): have had a mammogram within the last year but do not intend to have a mammogram within the following year; (d) contemplators (n = 86): have had a mammogram within the last year but intend to have it in the following year; (e) action (n = 103): have had a mammogram within the last year and plan to have another one within the following year; and (f) maintenance (n = 105): have had at least two or more mammograms on schedule (one every year) and plan to have another one within the following year.

Results

Relationships between Objective and Subjective Risk. The majority of women assessed their comparative risk as below average (40.1%; n = 146) or as average (43.4%; n = 158), with few reporting above-average risk (16.5%; n = 60). It was hypothesized that women with higher objective risk would report higher subjective risk. Furthermore, it was predicted that among the components of objective risk, family history would predict most powerful subjective risk. To test these predictions, proportional odds regression models were used in univariate analyses modeling the probability of perceiving oneself at above-average comparative risk. These analyses model the distribution of below-average, average, and above-average risk as a function of objective risk. The results are reported in Table 1.

As predicted, individuals with higher objective risk were more likely to report higher subjective risk. Among the components of objective risk, only the number of family members with a history of breast cancer predicted subjective risk; individuals with more relatives were more likely to report higher perceived risk. Furthermore, women who reported ever having had problems with their breasts (35.4%; n = 129) were more likely to report higher perceived risk.

The examination of attributions of subjective risk also provided support for the importance of heredity, physiology, and a lesser extent personal actions as factors that affected perceptions of risk. These results are presented in Table 2.

Consistent with the results of Aiken et al. (5), heredity was the most frequently mentioned category, followed by physiological and personal action attributions for breast cancer risk. In general, among women who perceived their risk as below average, heredity was viewed as a risk-decreasing factor, such that women who mentioned no family history of breast cancer felt less at risk. Similarly, physiological causes (e.g., age) were viewed primarily as risk-decreasing factors followed by personal action causes (e.g., exercise, diet, and not smoking). Among women who perceived their risk as above average, physiological and heredity causes were viewed primarily as risk increasing. Although the remaining categories were mentioned infrequently (only three people mentioned environmental causes), psychological causes (e.g., feeling hopeful) generally were viewed as producing average risk perceptions. In sum, attributions of perceived risk to heredity and physiological causes were most influential in determining whether a woman perceived her risk as below average, average, or above average.

Risk Predicting Stages of Change. It was predicted that objective and subjective risk would be related to stages of mammography screening, such that women with higher objective and subjective risk would be more likely to be in the later stages of adoption (e.g., action and maintenance). To test these predictions, univariate proportional odds regression analyses were

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6 In an as-yet-unpublished study, using a sample of 8914 women 50–80 years of age living in one of 40 selected communities in rural and suburban Washington state, Rakowski et al. (W. Rakowski, Anderson, and Stoddard; et al., unpublished manuscript) found as of 0.76 and 0.78 for the pro and con scales, respectively, that are identical to the items reported in this study. Although having a disproportionately greater number of con relative to pro items may produce concern, Rakowski et al., using confirmatory factor analysis, have found that reducing the number of con items to six reduces the internal consistency of the scale to 0.60. Hence, based on psychometric grounds, retaining the full 14-item con scale remains warranted. Clearly, more work is needed in improving the number and quality of pro and con items.

7 To obtain a global effect size for the relationship between objective and subjective risk, a Pearson correlation was calculated. The correlation was 0.21; P < 0.001.

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Table 1 Proportional odds regression analyses predicting subjective risk from objective risk indices

<table>
<thead>
<tr>
<th>Model</th>
<th>Odds ratio</th>
<th>95% confidence interval</th>
<th>Model χ²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall objective risk</td>
<td>1.01</td>
<td>2.74</td>
<td>1.65–4.56</td>
</tr>
<tr>
<td>Components of objective risk</td>
<td>1.78</td>
<td>5.94</td>
<td>2.91–12.11</td>
</tr>
<tr>
<td>Number of relatives with breast cancer</td>
<td>0.25</td>
<td>1.28</td>
<td>0.86–1.91</td>
</tr>
<tr>
<td>Number of breast biopsies</td>
<td>-0.15</td>
<td>0.85</td>
<td>0.60–1.23</td>
</tr>
<tr>
<td>Age at menarche</td>
<td>-0.13</td>
<td>0.88</td>
<td>0.71–1.09</td>
</tr>
<tr>
<td>Age at first live birth</td>
<td>0.61</td>
<td>1.19</td>
<td>1.25–2.72</td>
</tr>
</tbody>
</table>

8 β values represent unstandardized estimates. The odds ratio for overall objective risk is for a 0.10-unit change (e.g., going from a 10 to 20% risk).

9 P < 0.001.

10 P < 0.01.

Table 2 Relationship between Risk Attributions and Subjective Risk Perceptions

<table>
<thead>
<tr>
<th>Attributional category</th>
<th>Perceptions of risk (column percentages)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Below average</td>
</tr>
<tr>
<td>Personal action</td>
<td>33 (17.7)</td>
</tr>
<tr>
<td>Heredity</td>
<td>99 (53.2)</td>
</tr>
<tr>
<td>Psychology</td>
<td>15 (8.1)</td>
</tr>
<tr>
<td>Physiology</td>
<td>36 (20.4)</td>
</tr>
<tr>
<td>Chance</td>
<td>1 (0.5)</td>
</tr>
</tbody>
</table>
conducted, regressing stages of change onto subjective and objective risk, including its components. Stages of change were patterned as follows: precontemplation, relapse, relapse risk, contemplation, action, and maintenance. These analyses modeled the distribution of women across stages as a function of objective and subjective risk. These results are presented in Table 3.

Overall, these predictions were confirmed. Individuals with higher objective and subjective risk were consistently more likely to be in a later stage of mammography adoption. Among the components of objective risk, only the number of relatives with breast cancer predicted risk. Women with a family history were more likely to be in a later stage of adopting mammography. In addition, women who reported having had breast problems were more likely to be in a later stage of mammography adoption.

To determine which component uniquely predicted stages of change, a multivariable proportional odds logistic regression model was conducted, incorporating objective and subjective risk and self-reports of breast problems. If objective risk and self-reported breast problems are related to stages of change via their effects on increasing subjective risk, then including subjective risk in the regression model should render objective risk and self-reported breast problems nonsignificant predictors of stages of change (19). As the results at the bottom of Table 3 reveal, such a pattern was observed. Subjective risk uniquely predicted stages of change, such that women who reported increasing risk were more likely to be at a later stage. In sum, these results highlight significant relationships between subjective and objective risk and mammography stages of change and reveal that among the measures of risk, subjective risk served as the primary mediator of stages of change.

### Predicting Stage of Change from Risk and Decisional Balance

According to the TTM, stages of change are mediated by an individual’s perceived pros and cons of changing the behavior and, ultimately, decisional balance. Prochaska et al. (20) also include processes of change as mediators, but we were unable to include these measures due to constraints on the length of the interview. Whether risk perceptions continue to predict stages of change beyond the pros, cons, and decisional balance was examined next. It was first necessary to establish that the pro, con, and decisional balance scores predict significantly stages of change. Consistent with prior research (16, 17), it was expected that with progression among stages of change there would be an increase in pros, a decrease in cons, and a more positive decisional balance. The means for the pros, cons, and decisional balance as a function of stage are displayed in Table 4. As predicted, the average pro, con, and decisional balance scores followed these patterns.

To test further the significance of these trends, proportional odds regression analyses were performed, predicting stages of change from the pro, con, and decisional balance scores separately. These results are shown at the top of Table 5. Overall, a stronger endorsement of the pros and a more positive

<table>
<thead>
<tr>
<th>Stage of change</th>
<th>Pros</th>
<th>Cons</th>
<th>Decisional balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precontemplators</td>
<td>1.00 (4.6)</td>
<td>-6.37 (4.7)</td>
<td>7.37 (9.0)</td>
</tr>
<tr>
<td>Relapse</td>
<td>2.37 (2.9)</td>
<td>-8.03 (5.1)</td>
<td>10.40 (7.1)</td>
</tr>
<tr>
<td>Relapse risk</td>
<td>3.27 (2.3)</td>
<td>-10.90 (2.6)</td>
<td>14.20 (4.1)</td>
</tr>
<tr>
<td>Contemplators</td>
<td>4.11 (1.7)</td>
<td>-10.90 (3.4)</td>
<td>15.10 (4.4)</td>
</tr>
<tr>
<td>Action</td>
<td>4.46 (1.1)</td>
<td>-12.00 (2.8)</td>
<td>16.50 (3.2)</td>
</tr>
<tr>
<td>Maintenance</td>
<td>4.60 (0.9)</td>
<td>-12.10 (2.9)</td>
<td>16.70 (3.2)</td>
</tr>
</tbody>
</table>

* Larger mean values for the cons represent stronger disagreement with statements. Numbers in parentheses, SD.
Decisional balance predicted an increased likelihood of being in a later stage of mammography adoption; the opposite effect was observed for the cons. In sum, consistent with prior findings (16, 17), the pros, cons, and decisional balance were significant predictors of stages of change.

Having established in an earlier multivariate analysis that subjective risk, rather than objective risk or self-reports of breast problems, was the only significant predictor of stages, it was of interest to determine whether subjective risk continued to predict screening when the pro, con, and decisional balance scores were included in multivariate analyses. To test this, three proportional odds regression analyses were performed, regressing stages of change onto subjective risk with either the pro, con, or decisional balance scores included in the model. For these analyses, we removed one item from the con scale (see item 13 in the Appendix) that assessed perceived risk, to avoid confounding risk with other themes captured by con items and ultimately decisional balance. These results are presented in Table 5. For two out of three analyses, subjective risk continued to predict mammography stages of change. Specifically, with con or decisional balance scores in the models, heightened perceived risk continued to predict an increased probability of being in a later stage of mammography adoption; when the pro scores were included in the model, subjective risk did not predict significantly mammography stages of change.10 In all analyses, the pros, con, and decisional balance scores continued to predict stages of change in the hypothesized directions. Specifically, women who disagreed more often with the con statements, agreed more often with the pro statements, and had more favorable beliefs about mammography overall, were increasingly more likely to be in the later stages of adopting mammography.

Additional exploratory analyses were performed incorporating the con risk item (see item 13, “Appendix”). There were no significant changes in the results when this item was added to the con scores; however, subjective risk no longer predicted significantly mammography stages of change when the item was included as part of the decisional balance score ($P < 0.09$). This may suggest that part of the explanatory power of decisional balance to predict mammography stages of change, as measured in this study, stems from capturing the theme of personal risk.

### Table 5: Proportional odds regression analyses predicting stages of change

<table>
<thead>
<tr>
<th>Model</th>
<th>Subjective risk</th>
<th>Odds ratio</th>
<th>95% confidence interval</th>
<th>$\chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>Subjective risk</td>
<td>0.34</td>
<td>1.34</td>
<td>1.07-1.82</td>
</tr>
<tr>
<td>Model 2</td>
<td>Subjective risk</td>
<td>0.25</td>
<td>1.29</td>
<td>0.99-1.68</td>
</tr>
<tr>
<td>Model 3</td>
<td>Subjective risk</td>
<td>0.28</td>
<td>1.32</td>
<td>1.02-1.72</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>$\beta^*$</th>
<th>Odds ratio</th>
<th>95% confidence interval</th>
<th>$\chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>Pros</td>
<td>0.39</td>
<td>1.48$^*$</td>
<td>1.33-1.65</td>
</tr>
<tr>
<td>Model 2</td>
<td>Cons</td>
<td>-0.19</td>
<td>0.82$^*$</td>
<td>0.78-0.87</td>
</tr>
<tr>
<td>Model 3</td>
<td>Decisional balance</td>
<td>0.17</td>
<td>1.19$^*$</td>
<td>1.14-1.24</td>
</tr>
</tbody>
</table>

$^*$ $\beta$ values represent unstandardized estimates.
$^*$ $P < 0.001$.
$^*$ $P < 0.05$.

### Discussion

The present preliminary report highlights the need to explore further the relationship between subjective and objective risk and their relationships with stages of change. The findings highlight at least three important processes: (a) the relationships between subjective and objective risk were weak, with family history being the most salient feature among the objective risk indices in determining subjective risk; (b) consistent with prior findings (16, 17), the pro, con, and decisional balance scores predicted stages of change in the hypothesized directions. Thus, women who had more favorable beliefs specifically and overall, and disagreed more often with negative statements about mammography were increasingly more likely to be in the later stages of adopting mammography; and (c) subjective risk was related significantly to mammography stages of change in univariate analyses and continued to do so in multivariate analyses, including con and decisional balance scores in separate models. To our knowledge, these latter findings are the first explicit tests that demonstrate a significant relationship between risk perceptions and mammography stages of change as defined by the TTM. The implications of these results and how they apply to several of the TTM constructs will now be discussed.

Risk perceptions can be accommodated nicely within the TTM framework. Although stages of change represent temporal dimensions that describe the types of attitudes, intentions, and behaviors that people have, they do not describe what produces shifts among these stages. Hence, it is necessary to understand the strategies that people use (i.e., processes of change) to initiate and maintain behavioral change. One’s perceived risk, as the present results suggest, may be an important consciousness-raising mechanism, a process of change that helps to promote mammography screening. Helping women to become more aware of their risk of breast cancer through education, observation, reinterpretation, and correction of misperceptions may serve to increase mammography screening (20).

In addition to serving as a consciousness-raising mechanism, risk perception also may be related to other mediators that predict screening, such as the pros and cons of mammography, and ultimately decisional balance. For example, women who feel at risk may view mammography more favorably. Hence, in a causal chain, perceived risk may be an important precursor to whether mammography is viewed in a beneficial manner. Alternatively, women who view mammography positively may be more willing to admit they are at higher risk for breast cancer. These women may accept their higher risk, acknowledging that, due to mammography, breast cancer is likely to be detected early with a very favorable prognosis. Although the main aim of this study was not an in-depth examination of the relationships between risk perceptions and decisional balance processes, preliminary exploratory analyses revealed a few, albeit weak, relationships (see Footnote 9). In particular, women who reported higher perceived risk and breast problems had higher pro scores.

The relationships between subjective risk and decisional balance processes also were examined with respect to their ability to predict mammography stages of change. Subjective risk continued to predict mammography stages of change when the con and decisional balance scores were included in separate models, but not when the pro scores were added to the model. These results indicate that perceived risk contributes unique explanatory power beyond the con and decisional balance scores to predict stages and argue against a high degree of covariation between risk and these constructs. One view of these findings is that heightened perceived risk does not seem...
to act as a barrier to screening. That is, perceived risk seems to act independently of the cons, which can be viewed as barriers to screening. Another view is that more complex relationships exist between risk perceptions and the pros rather than the cons. Clearly, additional studies are needed that explore the relationships between risk perceptions and decisional balance processes and their ability to jointly and independently predict mammography screening. Some of these questions will be addressed as we continue to collect follow-up data from these women. In any event, to our knowledge, this is the first study to examine risk with mammography stages of change and decisional balance, with promising results.

Another goal of the present study was to assess the relationship between objective and subjective risk. Overall, objective risk, as measured by the Gail et al. (12) model, did predict subjective risk, such that women with higher objective risk also felt greater subjective risk. However, the overall strength of this relationship was modest, with a correlation of 0.21. These results, in combination with a few others (5, 6, 8), suggest that there is much room for improvement in enhancing the accuracy of perceived risk. Although there has been limited success to date, promising techniques are emerging. For example, Sumner et al. (21, 22) have developed an automated, modular utility assessment software program called U-Titer that has been used successfully to enhance perceived accuracy of breast cancer risk using the Gail et al. algorithm (12).

One possible reason why the relationship between objective and subjective risk, although significant, was modest, may refer to the current wording of the question. Specifically, the Gail et al. (12) model estimates lifetime risk of developing breast cancer. Women were asked to report their chances of developing breast cancer relative to other women within a period of 10 years. It is possible that having to make a comparative risk assessment within an attenuated time period may have produced weaker relationships than if women were asked for their own lifetime risk of developing breast cancer. Another possible explanation is that women may attend to only a few risk factors, or they may focus on risk factors that are weakly or not at all related to true objective risk. For example, women in this study paid particular attention to family history. A family history of breast cancer was the most influential contributor of subjective risk as revealed in the proportional odds regression analyses assessing the components of the Gail et al. (12) model and the descriptive analyses of attributions of perceived risk. The attributions of risk are particularly revealing. Although women who mentioned no family history of breast cancer correctly perceived themselves at lower risk, if this is the only piece of information they use to estimate their risk, it ultimately could deter them from mammography screening.

The present results do suggest that women pay attention to risk factors other than family history. The attributional analyses revealed that these women also were sensitive to physiological causes. Given their sensitivity to physiological factors, teaching women about other physiological risk factors may be more readily incorporated into their schema of breast cancer causes than if physiological attributes were not such components. Thus, it is necessary to highlight other physiological variables that promote increased risk. Indeed, in the present sample, and consistent with other findings (23), other physiological contributors to objective risk, such as number of biopsies, age at menarche, age at first live birth, and present age were nonsignificant predictors of subjective risk. These elements of risk should be communicated to women by their health care providers, and when possible, there should be attempts to personalize risk with recommended suggestions for action tailored to women's specific risk factors. Such strategies may ultimately improve informed decision-making about mammography screening (24, 25).

Although promising, the reader is cautioned as to the generalizability of these findings. The data were collected from women within a staff model health maintenance organization, and the results may not apply to women outside such settings. Furthermore, these results do not provide definitive support that adopting mammography screening occurs in stages or that risk perceptions follow a stage model. Rather, these data suggest an interpretable pattern between risk and stages of change. If behavioral change does occur in distinct, qualitatively different stages, as proposed by the TTM, then factors that affect individuals at one stage should have less or no effect on people in other stages (3, 26). Hence, if risk does affect change within a stage framework, it should be most influential for some people but not others. Unfortunately, the present findings do not allow a test of this hypothesis.

A formal test of the impact of risk perceptions within a stage model requires manipulating perceptions of risk, targeting people at various stages of change, and determining their effects. Fortunately, the Precaution Adoption Model (3) emphasizes the role of risk perceptions within a stage framework, and this model has been gaining empirical support (26, 27). Risk perceptions seem to have an important role early in modifying behavior. If this is indeed true, then modifying risk perceptions as a consciousness-raising strategy may be most influential for individuals in the precontemplation and contemplation stages of mammography adoption. Interventions that emphasize risk as well as the benefits of the recommended actions (e.g., pros) may be most influential for people in these stages and may merit further attention. Indeed, the explicit integration of personal risk perceptions with elements of the TTM may ultimately provide a more powerful model to assess behavioral changes across different health domains (28).

Acknowledgments

We thank Ellen Tambor for helping to code the attributional data and for comments on an earlier version of this manuscript. We also thank Dr. Mark Conway for his helpful statistical advice as well as Dr. William Rakowski for his advice in scale development. We also are grateful to the Kaiser Foundation Health Plan for providing access to its members and to Drs. Nancy Henley and Sam Weir and Jennifer Pearce for their support of and collaboration in this project.

Appendix: Pro and Con Statements

Pro Statements

1. Your family will benefit if you have a mammogram.
2. You [are/would be] more likely to go for mammograms if your doctor [tell|hold] you it is important for you.
3. Having mammograms every year or two gives you a feeling of control over your health.
4. Having mammograms every year or two gives you peace of mind about your health.
5. Women need mammograms even when they have no family history of breast cancer.

Con Statements

1. If you have breast exams from a doctor or nurse, you don’t need mammograms.
2. Mammograms often lead to surgery that is not needed.
3. Having mammograms causes a lot of worry or anxiety about breast cancer.
4. Once you have a couple of mammograms that are normal, you don’t need to have any more for a few years.
5. Mammograms are not needed for women your age.
6. You would not have a mammogram unless you had some breast problem or pain.
7. Having a mammogram is just looking for trouble.
8. The embarrassment caused by having a mammogram would make you have second thoughts about getting one.
9. You have so many other problems that you can't be bothered with having mammograms.
10. The cost of a mammogram would cause you to hesitate about getting one.
11. It is very hard for you to get to a place where they do mammograms.
12. There is so much information about how often women should get mammograms that you are confused.
13. You are less likely than other women your age to get breast cancer.
14. The pain caused by having a mammogram is bad enough to make you put off getting one.

References

Relationships among objective and subjective risk for breast cancer and mammography stages of change.

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