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Review

Meta-analyses of the effect of false-positive mammograms on generic and specific psychosocial outcomes

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Abstract

***Objectives*: While a previous meta-analysis found that false-positive mammography results affect women's likelihood of returning for screening, effects on well being have yet to be meta-analyzed. We investigated whether the effects of false-positive mammograms on women's well-being are limited to outcomes specific to breast cancer.**

***Methods*: We searched MEDLINE for studies of the psychosocial effects of false-positive results of routine screening mammography. We pooled effect sizes using random effects meta-analysis.**

***Results*: Across 17 studies ($n = 20\,781$), receiving a false-positive mammogram the result was associated with differences in all eight breast-cancer-specific outcomes that we examined. These included greater anxiety and distress about breast cancer as well as more frequent breast self-exams and higher perceived effectiveness of screening mammography. False positives were associated with only one of six generic outcomes (i.e. generalized anxiety), and this effect size was small.**

***Conclusions*: False-positive mammograms influenced women's well-being, but the effects were limited to breast-cancer-specific outcomes. Researchers should include disease-specific measures in future studies of the consequences of false-positive mammograms.**

Keywords: cancer; oncology; mammography; false positive; breast neoplasm

Introduction

While routine screening for cancer using mammograms is effective in saving lives [1], it often results in abnormal findings when cancer is not present (false positives). Over 10 years of routine screening, women in the United States have a 49% chance of receiving at least one false-positive mammogram result [2]. A recent meta-analysis found that false-positive screening mammograms affected women's likelihood of returning for subsequent screening. After a false positive mammogram, women in the United States were more likely to return, women in Canada were less likely to return, and there was no effect for women in European countries [3]. An accompanying narrative review of the long-term effects of false-positive screening mammograms suggested that women who receive false-positive results may have somewhat higher levels of distress and anxiety than those with normal test results, but it did not quantify these effects [3]. Some studies reported effects that lasted more than a year past the actual false-positive mammogram [4–6]. However, the nature of these effects on well-being remains unclear.

Studies of the psychosocial effects of false-positive mammograms typically assess two different types of outcomes: breast-cancer-specific outcomes (such as anxiety about breast cancer) and generic outcomes that apply to people regardless of their experiences with breast cancer (such as generalized anxiety). Although generic and disease-specific outcomes are both important to well-being, each one may have different implications. Generic measures allow the comparison of psychosocial outcomes across diseases; for instance, one may compare the consequences of false-positive mammogram results to false-positive cervical cancer screening results using the same generic measure, to draw conclusions about the consequences of receiving false-positive cancer-screening results. Furthermore, some of these generic measures address serious psychopathology or 'caseness' (for example, the Beck Depression Inventory [7] and the Hospital Anxiety and Depression Scale [8]). In contrast, disease-specific measures allow researchers to draw conclusions about clinically relevant aspects of well-being that are specific to the disease being studied.

The literature on quality of life distinguishes between disease-specific and generic measures. It has long been established that disease-specific quality-of-life measures can be more sensitive to small yet clinically important changes than generic measures [9–11]. Measures of well-being that are specific to breast cancer may similarly be better able to detect small changes due to a perceived threat to breast health as compared to generic measures.

Disease-specific outcomes may also be especially relevant to understanding future preventive behaviors. Research on attitudes and behavior supports a principle of compatibility: attitudes are most strongly predictive of future behavior when both are measured at the same level of specificity [12]. For example, in a study by Ajzen and Timko, health behaviors (such as getting regular dental checkups) were more highly correlated with attitudes toward those specific behaviors than with more general attitudes about preventive behaviors [13]. Similarly, HPV vaccine acceptability is associated with attitudes toward HPV vaccine, but not with attitudes toward vaccines in general [14]. In the context of false-positive mammogram results, the principle suggests that resulting anxiety about breast cancer, worry about breast cancer, and other attitudes toward breast cancer will be more closely related to whether a woman gets her next mammogram on time than generalized anxiety, generalized worry, or other generic measures.

For these reasons, breast-cancer-specific outcomes may be more sensitive measures of the impact of false positives and may be stronger predictors of women's future breast-related preventive behavior. This study addresses whether the effect of false positives is stronger for psychological variables that are specific to breast cancer. While the previous narrative review found an effect of false positives on outcomes related to well-being, it did not explore this important distinction of whether outcomes were specific to breast cancer. Our aim was to quantify the psychosocial consequences of receiving a false-positive mammogram and to investigate whether receiving a false-positive mammogram is associated with greater changes in breast-cancer-specific outcomes as compared to more generic measures of psychosocial outcomes.

Methods

Data sources and searches

We used the same search strategy as our earlier review [3] in order to identify any newly published articles. Two reviewers (NB and AR or TS) independently searched PubMed for papers whose title, abstract, or key words included reference to both false-positive results and screening mammography, published from August 1, 2006 (the end date of our earlier search) to November 2008. The search terms were (false positive OR abnormal OR benign) AND (breast cancer OR mammog*). We also manually searched the reference sections of relevant papers we obtained. We included articles from our earlier review in addition to newly identified articles.

Study selection

Two reviewers (TS and AR or NB) independently screened titles of articles, then the abstracts of relevant articles, and finally the articles themselves if they appeared pertinent. We identified studies that examined effects of false-positive mammogram results on women aged 40 and above using selection criteria specified before the review began. A detailed description of exclusion and inclusion criteria and included outcomes appears in Brewer *et al.* [3] Briefly, we required that studies were published in English, that initial mammography screening results were obtained from routine mammography (including from invitation-based and self-initiated programs), and that studies compared women receiving false positives to women from the same population who received normal results. We defined false positives as abnormal mammography results not followed by testing (including follow-up mammography, ultrasonography, magnetic resonance imaging, fine-needle aspiration, or biopsy) that identified breast cancer. Outcomes were well-being, attitudes, beliefs, and self-reported frequency of breast self-exam (BSE). Studies must have assessed these measures at least one month after the diagnosis of cancer was ruled out. We excluded studies not meeting quality criteria. Using these criteria, we identified one new article not included in the original review [15].

Data extraction

We combined data from identical study samples reported in multiple articles. Because our previous narrative review did not distinguish between generic outcomes and those specific to breast cancer [3], two investigators (TS and AR or NB) independently used a standardized data extraction form to code outcome variables from each study based on whether long-term psychosocial variables were related to breast cancer or were generic measures. We calculated a Fisher's z statistic and standard error for each breast-cancer-specific outcome and each generic outcome within a study. When there were multiple effect sizes for the same

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outcome for a single study, we weighted the effect sizes by variance and averaged them in order to provide a single estimate per outcome per study. We used the same method for combining assessments of an outcome at different time points within a single study (e.g. anxiety assessed at 2 months and again at 12 months) [16]. We grouped the outcomes we identified in the studies into categories, and we report results from categories that included at least three studies. We examined the original item wording when possible to identify the construct being measured, but we otherwise accepted the authors' categorizations of constructs. In practice, we categorized measures as assessing worry, fear, and anxiety if they included these or similar words. Distress was more typically assessed using a composite of multiple measures of negative affect.

Data synthesis and analysis

Using the 'metan' procedure in Stata (Version 10, StataCorp, College Station, TX), we conducted a random effects meta-analysis to pool effect sizes for each outcome category across studies [17]. The analysis weights effect sizes according to the variance in each study while also taking into account variability among studies. We report a correlation coefficient (r) for each outcome. Values of r between 0.10 and 0.30 represent small effect sizes, though these ranges are somewhat arbitrary [18]. We also report an I^2 statistic for heterogeneity, which measures the percentage of variation across studies that cannot be accounted for by chance. By convention, I^2 values of 25, 50, and 75% indicate low, moderate, and high heterogeneity, respectively [19].

Results

A total of 21 articles representing 17 studies with unique samples published between 1989 and 2007 addressed the effect of false-positive mammogram results on psychosocial outcomes. The study samples contained usable data for 20 781 participants (range 89–9578). Studies examined mostly clinical or convenience samples and one population-based sample of women from seven European countries, the United States, and Australia.

Breast-cancer-specific outcomes

Eight outcome categories included breast-cancer-specific outcomes (distress about breast cancer, somatization or symptoms in the breast, fear of getting breast cancer, anxiety about breast cancer, worry about breast cancer, perceived likelihood of breast cancer, perceived benefits of mammography, and frequency of breast self-exams) (Table 1). Of 28 breast-cancer-specific measures, 19 were *ad hoc* measures (typically 1 item) created for the study. Women who received a false-positive mammogram result had greater distress, fear, anxiety, and worry about breast cancer than women who received normal mammogram results (Table 2). False positives also were associated with increased somatization in the breasts, perception of a greater likelihood of getting breast cancer in the future, perception of greater benefits to mammography, and more frequent breast self-exams. The largest effect was for anxiety about breast cancer ($r = 0.22$), and the smallest was for fear ($r = 0.08$). All eight pooled effect sizes were statistically significant.

Generic outcomes

We identified six categories that included generic outcomes that were not specific to breast cancer (distress, somatization or symptoms, depression, fear, anxiety, and worry). Of 28 general measures, one was an *ad hoc* measure. In contrast to breast-cancer-specific outcomes, women who experienced false positives were no more likely than women with normal results to experience generalized distress, somatization, depression, fear, or worry. Across six generic outcomes, the only effect of false positives was that women who received false positives were more likely than women who received normal results to experience generalized anxiety ($r = 0.03$), though the lower confidence interval approached nonsignificance.

Comparison of breast-cancer-specific and generic measures

We were able to compare generic and breast-cancer-specific effect sizes for the following categories of outcomes: anxiety, distress, somatization, worry, and fear. The first four of these outcomes showed a greater pooled effect using breast-cancer-specific measures than generic measures. Although the effect sizes for fear did not differ between breast-cancer-specific and generic outcomes, the confidence interval for generalized fear was so wide that this estimate may not be reliable. Most effect sizes demonstrated heterogeneity, but it was not clearly greater for generic or breast-cancer-specific measures.

Discussion

Receiving a false-positive mammogram affected psychosocial outcomes specific to breast cancer, but it rarely affected generic well-being outcomes. The pattern of results is striking, with markedly larger pooled effect sizes among almost all breast-cancer-specific outcomes than the generic outcomes, and statistically significant effects in all of

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Table 1. Constructs assessed in meta-analyses of the consequences of false-positives

Construct	Study	Individual outcomes included under construct	Method of assessment	Outcome specific to breast cancer?	Sample size
Psychological distress					
	Barton *et al.* [24]	Generalized symptoms of distress related to past mammogram	Impact of Events Scale [34] [15 items]	Yes	1307
	Brett *et al.* [27]; Brett and Austoker [6]; Ong *et al.* [28]	Distress about breast cancer	Psychological Consequences Questionnaire [26] [12 items]	Yes	372
	Cockburn *et al.* [29]	Distress about breast cancer	Psychological Consequences Questionnaire [26] [12 items]	Yes	200
	Ellman *et al.* [35]	Symptoms of distress	General Health Questionnaire [21] [28 items]	No	553
	Gram *et al.* [4]	Stress	Not reported	No	278
	Lerman *et al.* [36,37]	Symptoms of distress about breast cancer	*Ad hoc* [1 item]	Yes	308
	Meystre-Agustoni *et al.* [30]	Symptoms of distress about breast cancer	Psychological Consequences Questionnaire [26] [12 items]	Yes	887
	Olsson *et al.* [31]	Symptoms of distress about breast cancer	Psychological Consequences Questionnaire [26] [12 items]	Yes	1222
		Distress about breast cancer	Psychological Consequences Questionnaire [26] [12 items]	Yes	524
	Sandin *et al.* [38]	Symptoms of global distress	Hopkins Symptoms Checklist-Revised [39] [90 items]	No	1195
	Tyndel *et al.* [15]	Distress about breast cancer	Psychological Consequences Questionnaire [26] [12 items]	Yes	1278
Somatization					
	Aro *et al.* [16]	Bodily preoccupation	Subscale of the Illness Attitude Scales [40] [27 items]	No	812
	Aro *et al.* [16]	Symptoms in breasts	*Ad hoc* measure [1 item]	Yes	830
	Ellman *et al.* [35]	General somatization	Subscale of General Health Questionnaire [21] [28 items]	No	553
	Gram *et al.* [4]	Taking sleeping pills, sleeplessness	Not reported	No	278
	Scaf-Klomp *et al.* [41]	Symptoms of distress, loss of appetite, sleep disturbances, somatization	General Health Questionnaire [21] [12 items]	No	170
Depression					
	Aro *et al.* [16]	Generalized symptoms of depression	Beck Depression Inventory [7] [21 items]	No	834
	Barton *et al.* [24]	Generalized symptoms of depression	Hopkins Symptom Checklist [42], subscale [17 items for both depression and anxiety]	No	1307
	Bull and Campbell [43]	Generalized symptoms of depression	Hospital Anxiety and Depression Scale [8], subscale [7 items]	No	577
	Ellman *et al.* [35]	Generalized symptoms of depression	General Health Questionnaire [21] [28 items], subscale	No	553
	Jatoi *et al.* [44]	Generalized feelings of sadness, feelings of everything being an effort, feeling worthless, generalized feelings of hopelessness	K6 Questionnaire [45] [3 of 6 items]	No	9574

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Table 1. *Continued*

Construct	Study	Individual outcomes included under construct	Method of assessment	Outcome specific to breast cancer?	Sample size
	Lampic *et al*. [5,46]	Generalized symptoms of depression	Hospital Anxiety and Depression Scale [8], subscale [7 items]	No	684
	Lipkus *et al*. [47]	Generalized symptoms of depression	Center for Epidemiologic Studies Depression Scale (CES-D), short form [48] [10 items]	No	1047
	Sandin *et al*. [38]	Generalized symptoms of depression	Hopkins Symptom Checklist-Revised [39], subscale [13 items]	No	1195
	Scaf-Klomp *et al*. [41]	Generalized symptoms of depression	Hospital Anxiety and Depression Scale [8], subscale [7 items]	No	161
Fear					
	Aro *et al*. [16]	Fear of death, fear of illness	Illness Attitude Scale [40], subscale [3 items]	No	820
	Sandin *et al*. [38]	Fear of breast cancer	*Ad hoc* [1 item]	Yes	1195
	Scaf-Klomp *et al*. [41]	Fear of cancer	*Ad hoc* [8 items]	No	158
Anxiety					
	Aro *et al*. [16]	Generalized symptoms of anxiety	State Trait Anxiety Inventory [49] [20 items]	No	829
	Barton *et al*. [24]	Generalized symptoms of anxiety	Hopkins Symptom Checklist [39], subscale [17 items for both depression and anxiety]	No	1307
	Bull and Campbell [43]	Generalized symptoms of anxiety	Hospital Anxiety and Depression Scale [8], subscale [7 items]	No	573
	Ellman *et al*. [35]	Generalized symptoms of anxiety	General Health Questionnaire [21] [28 items]	No	553
	Gram *et al*. [4]	Anxiety about breast cancer	not reported	Yes	318
	Jatoi *et al*. [44]	Generalized feelings of nervousness, restlessness	K6 Questionnaire [45] [2 of 6 items]	No	9578
	Lampic *et al*. [5,46]	Generalized symptoms of anxiety	Hospital Anxiety and Depression Scale [8], subscale	No	684
	Lampic *et al*. [5,46]	Anxiety about mammogram reattendence, anxiety about future mammograms	*Ad hoc* [11 items]	Yes	279
	Lerman *et al*. [36,37]	Anxiety about future mammograms	*Ad hoc* [1 item]	Yes	305
	Meystre-Augustoni *et al*. [30]	Anxiety about breast cancer	*Ad hoc* [1 item]	Yes	887
	Sandin *et al*. [38]	Generalized symptoms of anxiety, phobic anxiety	Hopkins Symptom Checklist-Revised [39], subscale [10 items]	No	1195
	Scaf-Klomp *et al*. [41]	Generalized symptoms of anxiety	Hospital Anxiety and Depression Scale [8], subscale [7 items]	No	154
Worry, intrusive thoughts, fear, and perceived risk					
	Aro *et al*. [16]	Worry about illness	Illness attitude scale [40], subscale [4 items]	No	824
	Aro *et al*. [16]	Worry about breast cancer	*Ad hoc* [1 item]	Yes	831
	Gram *et al*. [4]	Worry	Not reported	No	278
	Lerman *et al*. [36,37]	Worry about breast cancer	*Ad hoc* [1 item]	Yes	308
	Lipkus *et al*. [47]	Worry about breast cancer	*Ad hoc* [2 items]	Yes	1047

	Sandin *et al.* [38]	Worry about breast cancer	*Ad hoc* [1 item]	Yes	1195
	Scaf-Klomp *et al.* [41]	Worry about breast cancer	*Ad hoc* [1 item]	Yes	175
	Tyndel *et al.* [15]	Worry about breast cancer	Revised Cancer Worries Scale [36,37,50] [6 items]	Yes	1276
Perceived likelihood of breast cancer or disease					
	Aro *et al.* [16]	Perceived likelihood of breast cancer	*Ad hoc* [1 item]	Yes	787
	Lipkus *et al.* [47]	Perceived likelihood of breast cancer	*Ad hoc* [2 items]	Yes	1047
	Pisano *et al.* [51]	Perceived likelihood of breast cancer	Not reported	Yes	90
	Sandin *et al.* [38]	Perceived likelihood of breast cancer	*Ad hoc* [1 item]	Yes	1195
Perceived benefits of mammography					
	Gram *et al.* [4]	Perceived benefits of mammography	Not reported	Yes	278
	Lipkus *et al.* [47]	Perceived benefits of mammography	Rakowski Pros and Cons Scale [52] [20 items]	Yes	1047
	Pisano *et al.* [51]	Perceived benefits of mammography	Not reported	Yes	89
	Tyndel *et al.* [15]	Perceived benefits of mammography	*Ad hoc* [1 item]	Yes	1233
Frequency of Breast Self Exam (BSE)					
	Aro *et al.* [16]	Frequency of BSE	*Ad hoc* [1 item]	Yes	802
	Bull and Campbell [43]	Frequency of BSE	*Ad hoc* [1 item]	Yes	581
	Gram *et al.* [4]	Frequency of BSE	Not reported	Yes	278
	Lampic *et al.* [5,46]	Frequency of BSE	*Ad hoc* [1 item]	Yes	601
	Lerman *et al.* [36,37]	Frequency of BSE	*Ad hoc* [1 item]	Yes	299
	Scaf-Klomp *et al.* [41]	Frequency of BSE	*Ad hoc* [1 item]	Yes	175

Sample sizes reflect the mean sample size for the outcomes categorized as a single construct.

Table 2. Pooled effect sizes for psychosocial effects of false-positive mammograms

Outcome	Breast-cancer-specific				Generalized			
	Effect size	k	n	I^2	Effect size	k	n	I^2
Distress	0.16 (0.10–0.22)*	7	5574	76	−0.04 (−0.08–0.01)	3	2026	0
Somatization	0.12 (0.05–0.19)*	1	830	—	0.01 (−0.09–0.11)	4	1813	74
Depression					0.00 (−0.04–0.04)	9	15 931	74
Fear	0.08 (0.03–0.14)*	1	1195	—	0.11 (−0.18–0.39)	2	978	91
Anxiety	0.22 (0.18–0.27)*	4	1788	0	0.03 (0.00–0.07)*	8	14 873	55
Worry	0.12 (0.08–0.16)*	6	4832	51	0.02 (−0.04–0.08)	2	1102	0
Perceived likelihood	0.09 (0.04–0.14)*	4	3119	37				
Perceived benefits of mammography	0.11 (0.06–0.17)*	4	2647	40				
Frequency of breast self-exam	0.11 (0.04–0.19)*	6	2736	72				

Pooled effect sizes are r statistics. k = number of studies for each outcome, n = total number of participants included in pooled effect size, I^2 = heterogeneity. *$p<0.05$.

the breast-cancer-specific outcomes and only one of the generic outcomes.

The overall lack of measurable effect in generic measures of well-being suggests that receiving a false-positive mammogram result does not lead to worrisome levels of poor overall mental health. At the same time, breast-cancer-specific measures showed a lasting effect of false positives on thoughts about breast cancer and breast health. Not all of these breast-cancer-specific consequences of false-positive mammograms are negative. An increase in perceived likelihood of breast cancer and perceived benefit of mammography may increase women's likelihood of attending their next routine screening. Increased frequency of breast self-examinations does not decrease breast cancer risk [20], and overly frequent examinations may simply reflect anxiety about breast health.

Given that generic and breast-cancer-specific measures assess different aspects of well-being and demonstrate different responses to false-positive mammograms, which measures are more appropriate to use in future studies? It may be appropriate to use both types of measures, depending on the goals of the study. Generic measures of well-being assess more global aspects of mental health, which are important in their broad impact on daily life and their ability to be compared across studies of different diseases. However, some of the general well-being measures aim to uncover psychiatric disorders, which false positives are arguably unlikely to cause. As Broderson *et al.* [32] report, an inspection of the items on generic scales further supports the argument that the constructs that are measured are unlikely to be relevant after a breast cancer scare. For example, the Hospital Anxiety and Depression Scale elicits level of agreement with the statement, 'I have lost interest in my appearance', and the General Health Questionnaire asks whether the respondent has 'been thinking of yourself as a worthless person'. [8,22] It is unsurprising that instruments that assess such far-reaching impact show little or no effect in response to false positives. A related difficulty with some of the generic measures is their use of more immediate or 'state' measures rather than measures that assess well-being over the longer term. For example, a question about feeling anxious usually refers to how one feels right now, whereas feeling anxious about breast cancer suggests an ongoing concern. Generic measures may be less relevant to assess the effect of false positives, especially after at least one month has passed since cancer was ruled out.

At the same time, all studies of psychosocial consequences of false-positive mammograms should assess breast-cancer-specific outcomes. Outcomes specific to breast cancer may be more sensitive to important changes in attitudes toward and beliefs about breast health than generic outcomes. The quality-of-life literature makes a similar argument for measuring specific symptoms, such as fatigue, rather than the often overly general construct of overall quality of life [23,24]. In a comment on the use of generic quality-of-life measures, Vickers provides the example of acne treatment: while it may affect one's well-being, this important outcome is unlikely to be captured by items that assess generic or health-related quality of life, such as the ability to climb stairs [23]. Disease- and treatment-specific measures are more sensitive to important aspects of quality of life than generic measures of quality of life [9–11,24].

The ability of breast-cancer-specific measures to detect higher distress, anxiety, and somatization after a false positive suggests that interventions to reduce negative outcomes of false positives should focus on preventing or ameliorating harms to psychosocial well-being specifically related to breast health. For example, a large trial of an educational intervention to decrease anxiety after an abnormal mammogram found no effect of the intervention on generic scales of distress, anxiety, and depression [25]. It is possible that if differences existed due to the intervention, scales that measured breast-related well-being would have been more likely to detect them.

One difficulty with breast-cancer-specific measures of psychosocial outcomes is the paucity of validated scales with established psychometric properties and a clear correspondence with clinical status. Indeed, many of the breast cancer-specific assessments in this review were *ad hoc* single-item measures (see Table 1). This lack of formal validation limits the clinical interpretation of *ad hoc* measures [26]. Well-validated scales that address different breast-cancer-specific outcomes are needed. The Psychological Consequences Questionnaire (PCQ) is a breast cancer-specific scale designed to be used among women who have experienced a false-positive mammogram [27]. Researchers have used the PCQ, which has good psychometric properties, in numerous studies [6,15,28–32]. However, the scale combines different psychological constructs (e.g. depression and anxiety), its dimensional structure has differed among studies, and it is not theoretically based [17]. New measures would be most useful if they address distinct, theory-based psychosocial constructs and can be used to assess the impacts of false positives from other medical tests. Future research should focus on the development and validation of such scales.

Similarly, the *ad hoc* measures assess constructs that may not be perfectly distinct. Among the outcomes in this study, anxiety and worry may have some conceptual overlap. However, we conducted a sensitivity analysis in which these two outcomes were combined, and the same overall pattern of results was apparent: false positives were associated with increased worry and anxiety about breast cancer ($r = 0.16$, $p < 0.05$), and false positives had a smaller and not statistically significant on generalized anxiety and worry ($r = 0.03$, n.s.).

Strengths of this meta-analysis include the substantial sample size, rigorous review criteria, and random effects analysis. Limitations include that all studies in the review relied on correlational designs, though some used cross-sectional and others used longitudinal designs. Studies also used a range of sampling approaches, potentially limiting generalizability. While some studies used regional population-based samples, others used single-clinic and nonprobability samples. Some outcome categories included few studies, and some showed heterogeneity. While the experience of a false positive may differ widely, based on differing levels of invasiveness of follow-up testing or the different timing of follow-up testing, we were unable to investigate these potential differences. Because the purpose of this review was to investigate whether there was a broad pattern of stronger effects among outcomes specific to breast cancer, the clear pattern of results gives us confidence in our findings.

False-positive test results will be an increasingly common part of everyday life as new tests increase in number, direct-to-consumer marketing increases access to tests, and existing tests increase in sensitivity (often at the cost of increased false positives). Research suggests that people are willing to receive false-positive results from cancer tests and even expect it [33]. Although false-positive results may have beneficial effects on some women's subsequent screening behaviors, it is important to document and, as needed, intervene to mitigate the negative effects of receiving a false positive. Having sensitive, theory-based, and well-validated measures of the effects of false-positive tests is an important part of such activities.

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