

# Decreasing Women's Anxieties After Abnormal Mammograms: A Controlled Trial

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**Background:** Few studies have evaluated interventions to decrease a woman's anxiety after she receives an abnormal mammogram (i.e., one with a recommendation for follow-up). We performed a controlled trial to compare the effects of both an immediate reading of mammograms (i.e., a radiology intervention) and of an educational intervention that taught skills to cope with anxiety on the psychological status of women whose mammograms were normal or abnormal. **Methods:** Eligible women (n = 8543) aged 39 years or older were recruited from seven mammography sites at the time of their scheduled mammography screening and assigned to receive no intervention, either the radiology or the educational intervention, or both interventions. We used the Impact of Events Scale (IES) and the Hopkins Symptom Checklist subscales for Anxiety (HSC-A) and Depression (HSC-D) in structured telephone interviews of 2844 women to assess the psychological status of all women with abnormal mammograms (excluding women diagnosed with breast cancer) and of a random sample of women with normal mammograms at 3 weeks and 3 months after their mammograms. All statistical tests were two-sided. **Results:** We obtained usable 3-week interviews for 2390 (84%) women. By the 3-week interview, 1037 (72.1%) of the 1439 interviewed women with abnormal mammograms had completed the recommended work-up and knew that their abnormal mammograms were false positives. Women with abnormal mammograms had higher IES and HSC-A scores (i.e., more anxiety) than women with normal mammograms (mean IES scores: 4.97 [95% confidence interval {CI} = 4.47 to 5.50] and 1.82 [95% CI = 1.51 to 2.14], respectively;  $P < .001$ ; mean HSC-A scores: 1.14 [95% CI = 1.12 to 1.15] and 1.11 [95% CI = 1.09 to 1.13], respectively,  $P = .002$ ). Among women with false-positive mammograms, those who had received the radiology intervention reported less anxiety than those who had not (mean IES scores: 4.42 [95% CI = 3.73 to 5.07] and 5.53 [95% CI = 4.82 to 6.28], respectively,  $P = .026$ ). The educational intervention was not associated with any difference in psychological outcomes. Three months after the mammogram, by which time more than 80% of the women with abnormal results knew their mammograms to be false positives, anxiety levels of women with false-positive mammograms remained higher than those of women with normal mammograms (mean IES scores: 2.34 [95% CI = 1.99 to 2.69] and 1.15 [95% CI = 0.87 to 1.47], respectively,  $P < .001$ ). **Conclusion:** Immediate reading of screening mammograms, but not an educational intervention targeting coping skills, was associated with less anxiety among women with false-positive mammograms 3 weeks after mammography. [J Natl Cancer Inst 2004;96:529-38]

Mammography screening is an effective tool for the prevention of breast cancer mortality (1,2). However, many women have abnormal findings on screening mammograms that require further follow-up to eliminate the possibility of breast cancer. In the United States, approximately 5% (3) to 11% (4) of screening mammograms are accompanied by a recommendation for follow-up, and 97% of these are later found to be false-positives (i.e., abnormal mammograms that are not associated with a breast cancer diagnosis within 1 year) (4). It has been estimated that approximately 50% of women will experience one or more false-positive mammograms for every 10 screening mammograms they undergo (5). Many women become anxious after being told their mammogram is abnormal (6-12). This distress persists even after further evaluation proves the mammogram to have been a false positive (7,8,10).

Because false-positive mammographic results cannot be eliminated, we studied two interventions intended to decrease women's anxieties after receiving an abnormal mammogram reading. One intervention consisted of educational materials designed to explain the many possible reasons for abnormal mammograms and to teach coping strategies women could use while waiting for the results of follow-up evaluations (educational intervention). The other intervention was the real-time reading of mammograms by a radiologist, which made the immediate radiologic follow-up of mammographic abnormalities possible (radiology intervention). We performed a controlled trial to determine the effects of the two interventions, independently and combined, on the psychological status of women whose mammograms were read as abnormal.

## SUBJECTS AND METHODS

### Setting

Our study took place from February 1999 through January 2001 at Harvard Vanguard Medical Associates, a multispecialty group practice that cares for approximately 180 000 adults at 14 locations in the greater Boston metropolitan area. Mammogra-

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See "Notes" following "References."

DOI: 10.1093/jnci/djh083

Journal of the National Cancer Institute, Vol. 96, No. 7, © Oxford University Press 2004, all rights reserved.

phy facilities are located at seven sites. Radiologists who read mammograms at these facilities were board-certified and licensed by the State of Massachusetts.

### Subject Recruitment and Eligibility

Participants were recruited from among women scheduled for screening mammograms at the mammography facilities of Harvard Vanguard Medical Associates. Women were recruited either by research assistants or by mammographic technologists. Eligible women were age 39 years or older, were obtaining a screening (not a diagnostic) mammogram, had no history of breast cancer, and could speak English. Eligible women were invited to participate in the study after they checked in for their mammogram appointments; women who agreed to participate and who provided written informed consent were enrolled in the study and asked to provide a telephone number where they could be reached for telephone interviews. Subsequently, women whose study group allocation could not be determined ( $n = 169$ ), and women who were diagnosed with breast cancer in the following 12 months ( $n = 41$ ) were excluded from the study group.

### Study Design

Women who entered the study were assigned to one of four intervention groups: radiology intervention only, educational intervention only, both interventions, or neither intervention. The educational intervention was conducted at random in month-long intervals at the individual mammography sites, and each woman was therefore randomly allocated to the educational intervention according to the date of her mammogram appointment. Women were allocated non-randomly to the radiology intervention because it was administered on a part-time basis at six of the seven mammography sites according to radiologist coverage; thus, each woman received the radiology intervention according to radiologist coverage at the time of her mammogram. Women were notified about the results of their mammograms within 7 days of their mammogram.

We attempted to interview both all study participants with abnormal mammograms and a random sample of participants with normal mammograms by telephone at 3 weeks and at 3 months after their mammogram. Abnormal mammograms were defined as those with recommendations for further testing (e.g., additional mammographic views, ultrasound, or biopsy) or for which additional mammography views were obtained for non-technical reasons. To identify (and thus avoid interviewing) women with newly diagnosed breast cancer, we reviewed each woman's medical records and asked each woman we contacted whether she had been diagnosed with breast cancer before the interview commenced. Women who were diagnosed with breast cancer within 12 months after the mammogram were excluded from our study; thus all abnormal mammograms in our study were false-positive mammograms (i.e., abnormal mammograms that were not associated with a breast cancer diagnosis within the subsequent 12 months). Interviewers were blinded to intervention group assignment.

### Educational Intervention

We developed a 9-minute videotape and a 10-page, two-color pamphlet that were designed to reduce anxiety among women who had undergone screening mammography by capitalizing on

the "teachable moment" provided by the mammogram. The educational intervention was based on well-established behavioral theories (13–15) and supplied specific information and interpretations of potentially anxiety-provoking circumstances. The educational intervention also drew on the tenets of social learning theory (16) by providing role models in the videotape who were coping successfully with an abnormal mammogram. The pamphlet presented information about breast cancer risk, the risk of having an abnormal—and possibly false-positive—mammogram, explanations of follow-up procedures, tips for coping with uncertainty, and a glossary of terms associated with mammogram readings and common follow-up procedures. The videotape presented the story of a fictional woman who had an abnormal mammogram, her reaction, and how she learned facts about mammography and used coping strategies to lessen anxiety. The story was interspersed with narrative clinical information that referred to coping strategies outlined in the pamphlet.

Each month, different mammography sites were randomly assigned to administer the educational intervention; women who were scheduled for mammograms at a site that was administering the educational intervention were invited by the technologist or a research assistant to watch the videotape during their mammography visit and were given the pamphlet to read at their leisure. During months when a site was not assigned to administer the educational intervention, all intervention material was removed from the site.

### Radiology Intervention

The radiologists in our practice traditionally read mammograms after the women who had the mammograms had left the facility (i.e., batch reading). However, before the onset of our study, the Radiology Department of Harvard Vanguard Medical Associates established a schedule of on-site coverage in which all radiologists would read films immediately after mammograms were taken at prearranged sites and times. If necessary, additional mammography or ultrasound could be obtained before a woman left the mammography facility (although same-day aspiration or biopsy was not possible). Under this system, women received the preliminary results of their mammograms before they left the facility. All mammograms, regardless of whether they were initially read immediately or in batch, were later reread by a second radiologist. The radiologists rotated through the mammography facilities in such a way that each radiologist performed some immediate readings and some batch readings in the course of a week. Mammography technologists indicated on each participant's consent form whether or not her mammogram was read immediately.

### Data Collection and Outcome Measurements

We conducted separate telephone interviews, lasting 15–20 minutes, with each participant at 3 weeks and again at 3 months after her mammogram. We delayed the first interview for the small number of women who had not been notified of the initial results of their mammograms, so that all women interviewed at 3 weeks either knew the final result of their mammogram to be normal (all 951 of the women with normal mammograms, and 1037 [72.1%] of the 1439 women with abnormal screening mammograms) or were aware of the nature of further follow-up recommendations (the largest subgroup of these 1439 women [ $n = 262$ ; 18%] were waiting for 6-month follow-up mammograms).

In the interviews, we used two validated scales as subjective measures of stress: the Impact of Events Scale (IES) (17) and the Hopkins Symptom Checklist (HSC) anxiety (A) and depression (D) subscales (18). The IES, which measures psychological effects of a specified event (in this case, the mammogram) during the 7 days leading up to the interview (17), scores 15 items on a 4-point scale (sample item: “I thought about this mammogram when I didn’t mean to”; responses [weight]: not at all [0], rarely [1], sometimes [3], or often [5]). The weighted sum of the responses to all 15 items is the scale score, which can range from 0 to 75. The HSC-A and HSC-D subscales (18) consist of 17 items that measure anxiety and depression in the previous week on a scale from 1 (not at all) to 4 (extremely). Each HSC subscale was scored as the mean of responses to the relevant items. We also asked participants about their perceived breast cancer risk, about their perception of the results of their mammogram, about their history of previous false-positive mammograms, and about family history of breast cancer, ethnicity, education level, and marital status. We inquired about whether participants had reviewed the video and pamphlet and asked each woman to estimate how often she had used the coping strategies outlined in the pamphlet since having the mammogram.

Information about participants’ follow-up tests was obtained from automated radiology and medical records data. Follow-up tests were categorized as extra mammographic views, 6-month follow-up mammogram, ultrasound, or needle aspiration or biopsy. The Human Subjects Committee of Harvard Vanguard Medical Associates approved this study and the educational materials designed for it.

### Statistical Analysis

We conducted an intent-to-treat analysis. We compared the baseline characteristics among women by mammogram result and in the four intervention groups by using Student’s *t* test and analysis of variance for continuous characteristics and chi-square tests for categorical characteristics. We used Kruskal–Wallis tests to compare the psychological outcome scores of women with normal mammograms with those of women with false-positive mammograms and among women with false-positive mammograms (by intervention group, by follow-up recommendation, and by perceived results of mammogram) because the scores were not normally distributed. We also used Kruskal–Wallis tests to perform pairwise comparisons (i.e., immediate versus batch reading of mammograms and educational intervention versus no educational intervention) if no interaction effect between the two interventions was found. Confidence intervals (CIs) for the mean IES and HSC subscales scores were calculated via a bootstrap method (19). Chi-square tests were used to compare the proportions of women reporting any anxiety symptoms on the IES between groups (i.e., women with normal and women with false-positive mammograms, and women with false-positive mammograms by the four intervention groups and in pairwise comparisons) at both the 3-week and 3-month interviews for those who supplied data at both times. Our planned sample size of 350 women with false-positive mammograms in each of the four intervention groups had 80% power with a two-tailed alpha of .05 to detect a 5.3-point difference in mean IES scores between any two of the four groups.

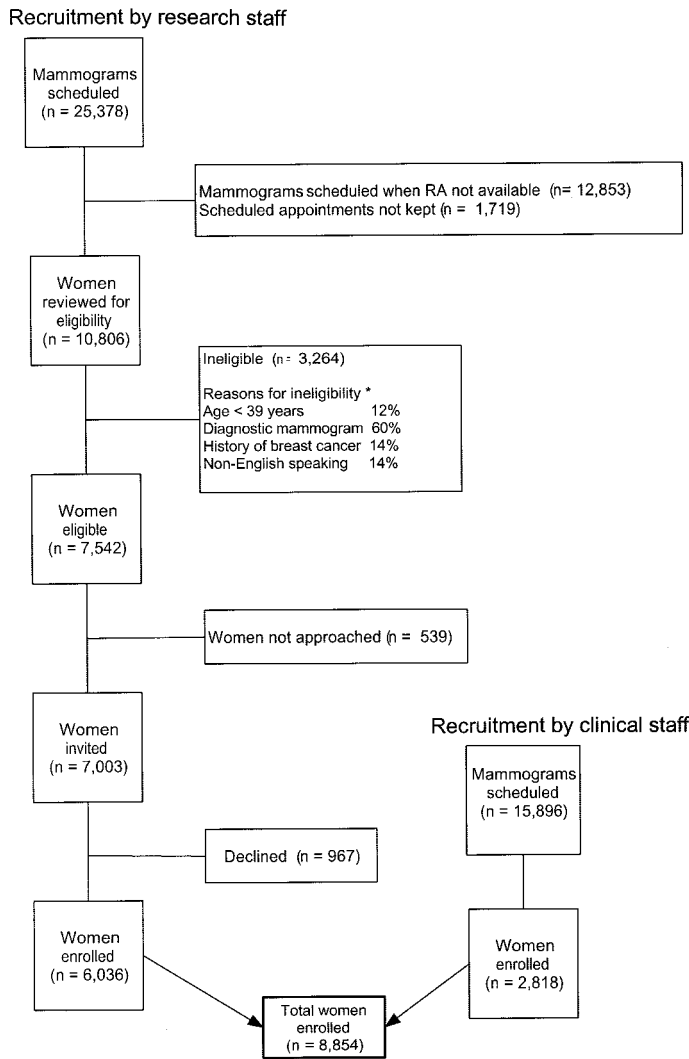
Women who were missing a response for only one of 15 items on the IES had the missing item replaced by the average of their other responses on this scale; women with more than one item missing were excluded from analyses using this outcome (15 women at the 3-week interview and 11 women at the 3-month interview). We used a two-step process (20) that controlled for important covariates to assess the effect of the interventions on women with false-positive mammograms at 3 weeks after the mammograms. We first used logistic regression analysis to predict the odds of reporting any distress on the IES. We then used linear regression analysis to predict increasing levels of distress symptoms among those women reporting distress. In the latter analysis, the outcome variable (IES score) was log-transformed to improve compliance with the assumptions of the model. The independent variables were educational and radiology intervention status (and an interaction term), age, education level, family history of breast cancer, and prior false-positive mammogram status. In models that considered any distress and log IES scores, we used mixed-effects models that considered the mammography facility in which a woman had her mammogram as a random effect to account for possible cluster randomization (21). The linear model for log IES score and the logistic model were fit by using the MIXED procedure and the GLIMMIX macro (available at: <http://ftp.sas.com/techsup/download/stat>, last accessed August 12, 2003), respectively, in SAS software (version 8.2; SAS Institute, Cary, NC). All statistical tests were two-sided.

### RESULTS

From February 1999 through January 2001, 41 274 mammograms were scheduled at the seven mammography facilities. Of these, 25 378 women received mammograms while research assistants recruited participants for the study; 6036 (86%) of the 7003 women invited to participate by research staff enrolled in our study (Fig. 1). The other 15 896 women received mammograms while mammography technologists recruited participants for this study; of those, 2818 women enrolled in the study (neither eligibility nor invitation was recorded individually for those women). Of the 8854 women enrolled in our study, 311 were subsequently excluded because study group allocation could not be determined ( $n = 169$ ), because they were diagnosed with breast cancer in the following 12 months ( $n = 41$ ), or because they were found to be ineligible after enrollment (e.g., women who did not speak English, whose mammogram was not a screening mammogram, or who were younger than 39 years of age;  $n = 101$ ). A total of 8543 women remained eligible and were assigned to one of the four intervention groups (Fig. 2).

Of the 8543 women assigned to an intervention group, 6801 (80%) had normal mammograms and 1742 (20%) had abnormal mammograms that were later classified as false positives (Fig. 2). The follow-up recommendations for women with abnormal mammograms that turned out to be false-positive mammograms ultimately included additional mammographic views (64%), 6-month follow-up mammograms (14%), ultrasound (13%), and aspiration or biopsy (9%).

We obtained usable 3-week interviews for 2390 (84%) of the 2844 women with whom interviews were attempted (Fig. 2) and 3-month interviews for 2034 (72%) women (data not shown). Among the women who completed the 3-week telephone interview, those with normal mammograms were older than those



**Fig. 1.** Recruitment of study participants. A total of 41 274 screening mammograms were scheduled during the study recruitment period; 25 378 while research assistants recruited women (left side of figure) and 15 896 while clinical staff (mammography technologists) recruited women (right side of figure). RA = research assistant. \*Reasons for ineligibility were based on a subsample of 785 ineligible women.

with false-positive mammograms (mean age 55.1 years versus 52.9 years,  $P < .001$ ) but were similar in other respects (Table 1). Among women in the four intervention groups with false-positive mammograms, the only characteristic that was statistically significantly different between the groups was education level; 26% of women who received the radiology intervention only had, at most, completed high school, compared with 20% of women who received both interventions, 18% of women who received the educational intervention only, and 15% of women who received neither intervention ( $P = .0013$ ).

### Effect of a False-Positive Mammogram on Measures of Anxiety

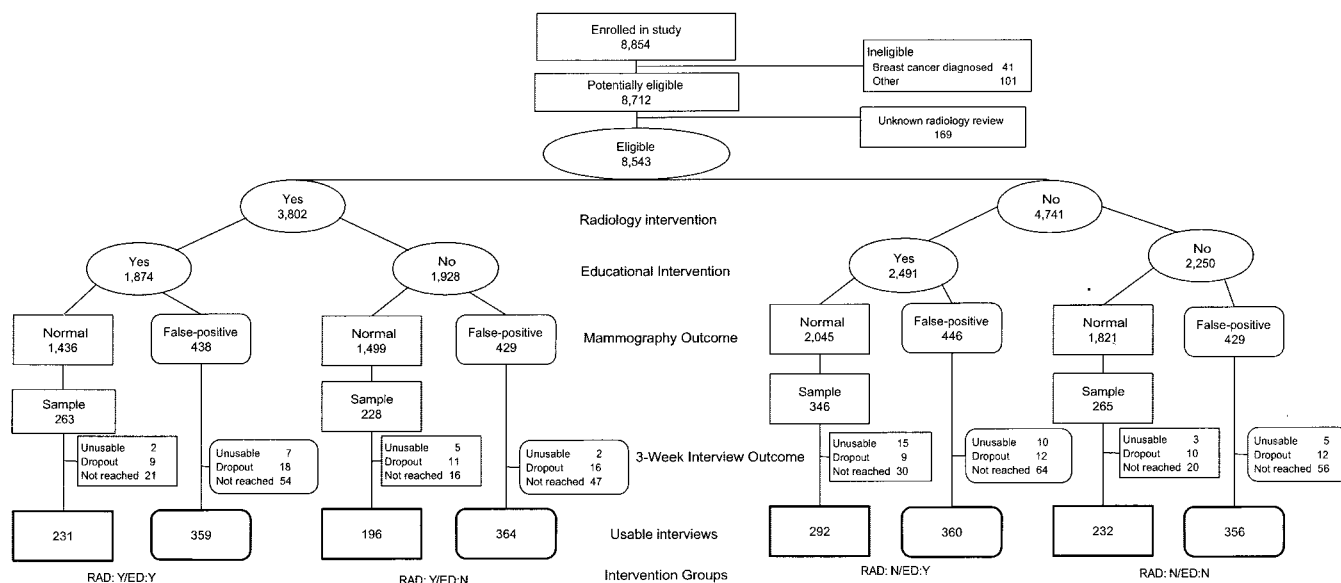
At 3 weeks after mammography, 1037 (72.1%) of the 1439 interviewed women with abnormal mammograms knew that they had a false-positive result. More of the 1439 women with a false-positive mammogram reported experiencing anxiety related to their mammogram (i.e., had an IES score  $> 0$ ) than did

women who had a normal mammogram (46.8% versus 28.3%, difference = 18.5%, 95% CI = 14.4% to 22.8%,  $P < .001$ ) (Table 2). Mean IES scores for women with false-positive mammograms and women with normal mammograms were 4.97 (95% CI = 4.47 to 5.50) and 1.82 (95% CI = 1.51 to 2.14), respectively ( $P < .001$ ) (Table 3). Compared with women who had normal mammograms, women who had false-positive mammograms had statistically significantly higher mean HSC-A scores (1.14 versus 1.11;  $P = .002$ ) and statistically nonsignificantly higher mean HSC-D scores (1.19 versus 1.16;  $P = .11$ ). Three months after the mammogram, by which time more than 80% of the women with abnormal results knew their mammograms to be false positive, women with false-positive mammograms reported less anxiety than they had at 3 weeks after the mammogram, but they had a mean IES score at 3 months that was higher than that of women with normal mammograms (2.34 versus 1.15;  $P < .001$ ). There were no statistically significant differences in mean HSC subscale scores between these two groups at 3 months after mammography.

Women who were advised to have more intensive follow-up after having an abnormal mammogram had greater levels of distress than did women with less intensive follow-up recommendations at 3 weeks and at 3 months after their mammogram. The mean IES scores at 3 weeks were 12.0 (95% CI = 9.7 to 14.4) for women with a biopsy or fine-needle aspiration recommendation, 8.3 (95% CI = 6.5 to 10.3) for women with a recommendation for ultrasound, 5.9 (95% CI = 4.6 to 7.4) for women with a recommendation for 6-month follow-up mammogram, and 3.1 (95% CI = 2.6 to 3.5) for women recommended for extra mammographic views within a few days of the original mammogram ( $P < .001$  for differences among all women). These higher levels of distress at 3 weeks after the mammogram were also reflected in higher mean HSC-A scores, which were 1.22 (95% CI = 1.16 to 1.28) for women with a recommendation for biopsy or aspiration, 1.14 (95% CI = 1.09 to 1.20) for women with a recommendation for ultrasound, 1.14 (95% CI = 1.09 to 1.18) for women with a recommendation for a 6-month follow-up mammogram, and 1.12 (95% CI = 1.11 to 1.14) for women with a recommendation for extra mammographic views ( $P = .01$  for differences among all women) (data not shown). At 3 months after the mammogram, the mean IES scores were 4.19 (95% CI = 2.36 to 6.31) for women with a recommendation for biopsy or aspiration, 3.44 (95% CI = 2.45 to 4.65) for women with a recommendation for a 6-month follow-up mammogram, 2.73 (95% CI = 1.76 to 3.76) for women with a recommendation for an ultrasound, and 1.63 (95% CI = 1.28 to 2.03) for women with a recommendation for extra mammographic views ( $P < .001$  for differences among all women) (data not shown).

### Effect of the Interventions on Women With False-Positive Mammograms

**Psychological outcomes.** Among women with false-positive mammograms, there were no statistically significant differences in anxiety scores, as measured by the mean values of the IES or the two HSC subscales, among the four intervention groups (Table 3). However, when we examined the results only according to whether or not women received the radiology intervention, we found that women with abnormal mammograms whose mammograms were read immediately reported lower levels of anxiety at 3 weeks after the mammogram than did women who



**Fig. 2.** Study design and progression of subjects. Allocation of interventions and size of the study groups as of the 3-week interview. RAD = radiology intervention; ED = educational intervention; Y = yes; N = no.

did not receive the radiology intervention (i.e., those whose mammograms were read in batch) (mean IES scores: 4.42 and 5.53, respectively;  $P = .026$ ) (Table 3). Although there was still a difference in mean IES scores between these two groups of women at 3 months after the mammograms, it was no longer statistically significant (mean IES scores for women who did and did not receive the radiology intervention were 1.94 and 2.74, respectively;  $P = .18$ ). Compared with women who did not receive the educational intervention, women who received the educational intervention scored lower on the HSC-A at 3 months (1.11 versus 1.14;  $P = .051$ ), but not at 3 weeks (1.14 versus 1.13;  $P = .57$ ), after the mammogram.

Similar percentages of women in the four intervention groups reported having anxiety on the IES (Table 2). Among the women with false-positive mammograms in each of the four intervention groups, the percentage of women reporting any anxiety symptoms (i.e., the percentage of women with IES scores  $>0$ ) decreased between 3 weeks and 3 months after mammography; at 3 months after mammography, the group that received both interventions contained the lowest percentage of women reporting anxiety ( $P = .036$ , chi-square test) (Table 2). Although a smaller percentage of women who received the radiology intervention reported any anxiety than women who did not receive the radiology intervention, both at 3 weeks (43.8% versus 49.8%; difference = 5.9%, 95% CI = 0.3 to 11.5%,  $P = .039$ ) and at 3 months (25.6% versus 30.1%; difference = 4.5%, 95% CI =  $-.6$  to 9.5%,  $P = .083$ ) after the mammogram, the difference was statistically significant only at 3 weeks after the mammogram (Table 2). The educational intervention was not associated with different levels of anxiety at either time point (percentages of women who received the educational intervention versus those who did not, reporting any anxiety at 3 weeks were 47.3% versus 46.5% [difference =  $-0.8\%$ , 95% CI =  $-6.4\%$  to 4.8%;  $P = .78$ ] and at 3 months were 26.2% versus 29.6% [difference = 3.4%, 95% CI =  $-1.7\%$  to 8.4%;  $P = .19$ ]) (Table 2).

Overall, at 3 months after mammography, approximately 28% of women who had false-positive mammograms reported

any anxiety symptoms, compared with approximately 18% of women with normal mammograms (difference = 9.9%, 95% CI = 6.3% to 13.6%;  $P < .001$ ). To determine whether this difference was the result of diagnostic uncertainty among women with ongoing evaluations, we determined the status of the 339 women with false-positive mammograms who reported anxiety at 3 months. Of these women, 240 women (71%) knew that their original results were false positives by 3 months, 91 (27%) were awaiting 6-month follow-up mammograms, and eight (2%) were awaiting other follow-up testing. Thus, the persistence of anxiety after abnormal mammographic findings is not primarily caused by diagnostic uncertainty and is mostly accounted for by women who already knew that they did not have cancer.

IES scores were also associated with women's perceptions of the results of their mammograms at 3 weeks after their mammograms. Of the 1439 women with abnormal mammograms that turned out to be false positive (1037 [72.1%] of whom knew their mammogram was normal by the 3-week interview), 697 (48%) told us at the 3-week interview that their mammogram had been normal (56% of those with immediate review and 41% of those with batch reading reported that their mammograms had been normal), indicating that, for some women, immediate completion of follow-up so minimized the effect of the experience that they never perceived their mammogram as having any abnormality. Women who had had an abnormal mammogram but who believed that it had been normal had a mean IES score of 2.10 (95% CI = 1.73 to 2.49), compared with mean IES scores of 6.33 (95% CI = 5.12 to 7.71) for women understanding that they had needed extra views, 6.40 (95% CI = 4.85 to 8.00) for women understanding that they needed a repeat mammogram in 6 months, and 10.00 (95% CI = 8.45 to 11.67) for women understanding that they needed "more testing" ( $P < .001$ ) (data not shown).

Neither intervention was associated with lower levels of anxiety at 3 weeks among 133 women who had a false-positive mammogram and for whom a breast biopsy was recommended. The mean IES scores were 15.5 (95% CI = 9.2 to 22.8) for women who received both interventions, 9.9 (95% CI = 5.0 to

**Table 1.** Characteristics of the study population\*

Characteristic	Women with normal mammogram results (n = 951)	Women with false-positive mammogram results (n = 1439)	P†	Women with false-positive mammogram results				P†
				RAD:Y/ED:Y (n = 359)	RAD:Y/ED:N (n = 364)	RAD:N/ED:Y (n = 360)	RAD:N/ED:N (n = 356)	
Mean age, y (SD)	55.1 (10.3)	52.9 (9.3)	<.001	53.5 (9.7)	53.5 (10.3)	52.3 (8.7)	52.3 (8.4)	.14
	No. (%)	No. (%)		No. (%)	No. (%)	No. (%)	No. (%)	
Family history of breast cancer	304 (33)	481 (34)	.39	115 (33)	128 (36)	120 (33)	118 (33)	.78
Relationship of relative with breast cancer			.87					
Mother	81 (27)	128 (27)						
Sister	47 (16)	65 (14)						
Daughter	2 (1)	3 (1)						
<u>Mother, sister, or daughter</u>				42 (37)	50 (39)	49 (41)	55 (47)	.37
Aunt or grandmother	133 (44)	227 (47)						
Other	39 (13)	56 (12)						
<u>Aunt, grandmother, or other</u>				73 (63)	78 (61)	71 (59)	61 (53)	
Ethnicity			.79					
White	756 (80)	1145 (81)		293 (83)	283 (79)	297 (83)	272 (78)	.41
African American	120 (13)	182 (13)		42 (12)	52 (15)	39 (11)	49 (14)	
Latina/Hispanic	23 (2)	36 (3)						
Asian/Pacific Islander	15 (2)	28 (2)						
Native American	7 (1)	8 (1)						
Other	19 (2)	19 (1)						
<u>Latina/Hispanic, Asian/Pacific Islander, Native American, or other</u>				19 (5)	21 (6)	22 (6)	29 (8)	
Education			.018					
8 <sup>th</sup> grade or less	11 (1)	14 (1)						
Some high school	8 (1)	40 (3)						
High school graduate	166 (18)	227 (16)						
<u>8<sup>th</sup> grade or less, some high school, or high school graduate</u>				70 (20)	94 (26)	65 (18)	52 (15)	.0013
Some college	166 (18)	234 (16)						
College graduate	193 (21)	323 (23)						
<u>Some college or college graduate</u>				151 (42)	137 (38)	135 (38)	134 (38)	
Graduate school	392 (42)	586 (41)		135 (38)	126 (35)	160 (44)	165 (47)	
Marital status			.046					
Married	570 (61)	867 (61)						
Living with a partner	53 (6)	80 (6)						
<u>Married or living with a partner</u>				228 (64)	240 (67)	246 (69)	233 (66)	.33
Divorced/separated	117 (12)	210 (15)						
Widowed	81 (9)	80 (6)						
<u>Divorced/separated or widowed</u>				83 (23)	78 (22)	63 (18)	66 (19)	
Single	120 (13)	185 (13)		44 (12)	39 (11)	49 (14)	53 (15)	

\*Not all categories add up to totals because of non-response to some items. Categories grouped for the four-way comparison are underlined. SD = standard deviation; RAD = radiology intervention; ED = educational intervention; Y = yes; N = no.

†P values for comparisons of mean ages were estimated using Student's *t* test; P values for comparisons of proportions were estimated using chi-square tests. All P values are two-sided.

**Table 2.** Percentage of women with Impact of Event Scale summary scores greater than 0 at 3 weeks and at 3 months after the mammogram event by mammogram outcome and intervention group

Intervention group	Mammogram outcome	3 wk % (95% CI)	P†	3 mo % (95% CI)	P†
All	Normal	28.3 (25.1 to 31.4)	<.001	18.0 (15.3 to 20.6)	<.001
	False-positive	46.8 (44.0 to 49.7)		27.9 (25.4 to 30.4)	
RAD: Y/ED: Y	False-positive	44.1 (38.4 to 49.7)	.23	21.4 (16.7 to 26.0)	.036
RAD: Y/ED: N		43.6 (38.0 to 49.3)		29.9 (24.7 to 35.1)	
RAD: N/ED: Y		50.3 (44.7 to 56.0)		30.9 (25.7 to 36.1)	
RAD: N/ED: N		49.2 (43.6 to 54.8)		29.3 (24.2 to 34.4)	
RAD: Y	False-positive	43.8 (41.0 to 46.6)	.039	25.6 (23.2 to 28.1)	.083
RAD: N		49.8 (46.9 to 52.6)		30.1 (27.5 to 32.7)	
ED: Y	False-positive	47.3 (43.3 to 51.2)	.78	26.2 (22.7 to 29.7)	.19
ED: N		46.5 (42.5 to 50.4)		29.6 (26.0 to 33.2)	

\*CI = confidence interval; RAD = radiology intervention; Y = yes; ED = educational intervention; N = no; NA = not applicable.

†Two-sided chi-square test.

**Table 3.** Psychological outcomes among women with normal and false-positive mammograms and among those with false-positive mammograms by intervention status 3 weeks and 3 months after the mammogram event\*

Interview	Mammogram outcome												
	Women with normal mammograms				Women with false-positive mammograms				Women with false-positive mammograms				
	By intervention group		By radiology intervention		By educational intervention		By intervention group		By radiology intervention		By educational intervention		
	RAD:Y/ED:N	RAD:N/ED:Y	P†	RAD:Y/ED:Y	RAD:N/ED:N	RAD:N/ED:Y	P†	RAD:Y	RAD:N	ED:Y	ED:N	P†	
3 wk	1.82 (1.51 to 2.14)	4.97 (4.47 to 5.50)	<.001	4.53 (3.69 to 5.59)	4.32 (3.39 to 5.27)	6.09 (5.03 to 7.27)	4.97 (4.04 to 6.06)	.09	4.42 (3.73 to 5.07)	5.53 (4.82 to 6.28)	5.31 (4.62 to 6.08)	4.64 (4.03 to 5.33)	.35
3 mo	1.15 (0.87 to 1.47)	2.34 (1.99 to 2.69)	<.001	1.61 (1.12 to 2.14)	2.28 (1.66 to 2.96)	2.85 (2.08 to 3.69)	2.62 (1.90 to 3.45)	.21	1.94 (1.50 to 2.35)	2.74 (2.21 to 3.30)	2.23 (1.76 to 2.72)	2.45 (1.99 to 3.00)	.63
<i>Mean Impact of Events Score (95% CI)</i>													
3 wk	1.11 (1.09 to 1.13)	1.14 (1.12 to 1.15)	.002	1.13 (1.10 to 1.16)	1.14 (1.11 to 1.18)	1.15 (1.12 to 1.18)	1.13 (1.10 to 1.15)	.64	1.14 (1.11 to 1.16)	1.14 (1.12 to 1.16)	1.14 (1.12 to 1.16)	1.13 (1.11 to 1.16)	.57
3 mo	1.11 (1.09 to 1.13)	1.12 (1.11 to 1.14)	.49	1.10 (1.07 to 1.13)	1.15 (1.11 to 1.19)	1.11 (1.09 to 1.14)	1.13 (1.10 to 1.16)	.08	1.12 (1.10 to 1.15)	1.12 (1.10 to 1.14)	1.11 (1.09 to 1.13)	1.14 (1.11 to 1.16)	.051
<i>Mean Hopkins Symptom Checklist score, Anxiety Subscale (95% CI)</i>													
3 wk	1.16 (1.14 to 1.18)	1.19 (1.17 to 1.21)	.11	1.17 (1.14 to 1.20)	1.20 (1.16 to 1.23)	1.21 (1.18 to 1.25)	1.18 (1.15 to 1.21)	.66	1.18 (1.16 to 1.21)	1.20 (1.17 to 1.22)	1.19 (1.17 to 1.21)	1.19 (1.17 to 1.21)	.34
3 mo	1.15 (1.13 to 1.17)	1.18 (1.17 to 1.20)	.15	1.16 (1.13 to 1.19)	1.21 (1.17 to 1.25)	1.20 (1.16 to 1.23)	1.18 (1.15 to 1.21)	.45	1.18 (1.16 to 1.21)	1.19 (1.16 to 1.21)	1.18 (1.15 to 1.20)	1.19 (1.17 to 1.22)	.40
<i>Mean Hopkins Symptom Checklist score, Depression Subscale (95% CI)</i>													

\*CI = confidence interval, RAD = radiology intervention, ED = educational intervention, Y = yes, N = no.

†Kruskal-Wallis test, two-sided.

15.5) for women who received the radiology intervention only, 10.1 (95% CI = 5.6 to 14.5) for women who received the educational intervention only, and 12.5 (95% CI = 9.0 to 16.5) for women who received neither intervention ( $P = .46$ ). Among women with false-positive mammograms and recommendations for follow-up that did not include biopsy, the mean IES score for women who received the radiology intervention (3.8, 95% CI = 3.2 to 4.4) was lower than that among women who did not (4.8, 95% CI = 4.1 to 5.5) ( $P = .039$ ) (data not shown).

The radiology intervention was associated with lower perceived risk of breast cancer: 20% of women whose mammograms were read immediately versus 33% of women whose mammograms were read in batch reported having thought they might have breast cancer at the time they got their mammogram results (difference = 13%, 95% CI = 8.5 to 17.6%;  $P < .001$ , chi-square test). In contrast, the educational intervention was not associated with a difference in women's perceived risks of breast cancer ( $P = .7$ ) (data not shown).

After controlling for age, prior false-positive mammograms, family history of breast cancer, education level, race (none of which were independently statistically significantly associated with the outcome), and clinical site, we found that the radiology intervention was associated with decreased odds of reporting anxiety symptoms on the IES at 3 weeks after mammography (OR = 0.78, 95% CI = 0.61 to 0.99), whereas the educational intervention was associated with increased odds of reporting anxiety symptoms at 3 weeks after mammography (OR = 1.23, 95% CI = 0.99 to 1.53). When we controlled for all the variables in the logistic regression model, we found that, among women reporting anxiety, women who received the radiology intervention had IES scores that were 20% (95% CI = 3% to 33%) lower than women who did not (data not shown). The educational intervention had no statistically significant effect on IES scores. We found no evidence for an interaction between the two intervention terms (data not shown).

#### Women's reactions to the educational intervention.

Among the women who were assigned to the educational intervention, 72% recalled receiving the pamphlet, 61% reported reading it, and 78% recalled viewing the videotape. In contrast, only 9% of the group not assigned to the educational intervention recalled seeing a pamphlet, and only 1.4% recalled seeing a videotape, indicating that the educational intervention was well recalled by those who were exposed to it and that there was minimal contamination between the groups that were and were not assigned to receive it. The mean numbers of coping strategies used by women who did and did not receive the educational intervention (the strategies were specified in the educational intervention materials) were 1.82 and 1.51, respectively (difference = 0.31, 95% CI = .16 to .45;  $P < .001$  Student's  $t$  test). Individual coping strategies used by the women in our study are listed in Table 4. Study participants commented favorably on the educational intervention: Of those who said they watched the videotape, 70% reported it helped them feel better, and of those who remembered the pamphlet, 80% felt that it was helpful.

## DISCUSSION

We found that 3 weeks after mammography, nearly 50% of the women who had a false-positive mammogram reported having symptoms of anxiety about the mammogram, compared with 28% of women with normal mammograms. Even 3 months after

**Table 4.** Reported use of coping strategies among women with false-positive mammograms\*

Coping strategy	Women assigned to receive the educational intervention (n = 719) % (95% CI)	Women not assigned to receive the educational intervention (n = 720) % (95% CI)	P†
Talking to a friend about the experience	68.3 (64.9 to 71.7)	66.1 (62.6 to 69.6)	.35
Reading to learn more about mammography	30.0 (26.7 to 33.3)	14.5 (11.9 to 17.1)	<.001
Exercising or taking a walk to distract oneself	22.1 (19.1 to 25.1)	17.5 (14.7 to 20.3)	.026
Asking one's doctor questions regarding the mammogram	17.3 (14.5 to 20.1)	15.6 (12.9 to 18.3)	.41
Trying deep breathing or relaxation techniques	14.6 (12.0 to 17.2)	14.4 (11.8 to 17.0)	.91
Trying to avoid negative thoughts about the mammogram	29.9 (26.6 to 33.2)	24.1 (21.0 to 27.2)	.013

\*Percentage of women reporting using the coping strategy at least once since having the mammogram during the 3-week telephone interview. CI = confidence interval.

†Two-sided chi-square test.

the mammogram, 28% of women with false-positive mammograms reported anxiety related to their mammogram. The immediate mammogram reading and feedback provided by the radiology intervention was associated with lower average anxiety scores compared with the condition of the batch-reading patients at 3 weeks after the mammogram for all women except those for whom a biopsy was recommended. A majority of women with immediate readings did not realize that they had had abnormal mammograms, and we suspect that this was one reason that the radiology intervention was associated with reduced anxiety scores. In contrast, the educational intervention was not associated with a decrease in anxiety scores at 3 weeks after an abnormal mammogram. By 3 months after mammography, anxiety scores were similar regardless of the type of intervention a woman received and remained somewhat elevated compared with those of women with normal mammograms.

We were surprised that the educational intervention did not help to reduce women's anxieties after receiving an abnormal mammogram. Even though the educational intervention was based on well-established behavioral theories and women reported using several of the recommended coping strategies, it is possible that it may have increased anxiety in the short term. However, women also reported that the intervention helped them. We do not know what might account for these contradictory findings. It is possible that the psychological measures we used may be one source of the contradiction because our educational intervention encouraged women to use avoidance techniques to cope with anxiety, and one of the things that the IES measures, in part, is avoidance behaviors; therefore, although women who received the educational intervention did not have lower IES scores than those who did not, women who followed the advice in the educational intervention might have been using the suggested coping strategies and, as a result, feeling better than women who did not receive the educational intervention. There may have been a mixed effect of the educational intervention; for example, a qualitative study (22) reported that some women with abnormal mammograms found that receiving detailed medical information was disturbing, accentuated their fears, and made the wait for follow-up tests more difficult. Furthermore, we may have interfered with women's denial, which may be a helpful mechanism for coping with anxiety (23), by providing detailed information about the implications of an abnormal mammogram and drawing more attention to the event. It is possible that different types of interventions, such as direct counseling by a health professional, would be needed to achieve a substantial reduction in women's anxieties related to breast

cancer. Our finding that the radiology intervention was associated with less anxiety than the educational intervention indicates that rapid evaluation of mammographic abnormalities may be a more effective approach to decreasing women's anxieties than trying to change emotional reactions to an abnormal mammogram. Other approaches to diminish anxiety on the part of patients, such as the quality-control efforts to minimize the number of call-backs that are already used in many mammography facilities, are also worth taking.

We found that women who were advised to have 6-month follow-up mammograms reported relatively high anxiety levels. Unlike most other women with abnormal mammograms who knew by the 3-month interview that their mammograms were false positives, these women were still waiting to complete their follow-up at the 3-month interview. It is likely that the delay built into the 6-month evaluation recommendation causes women to feel more concern about this recommendation than is warranted, given that most radiologists often recommend this type of follow-up for only mildly suspicious abnormalities. Several researchers have suggested that radiologists reconsider making recommendations for 6-month follow-up mammograms and that they either evaluate women immediately or on an annual basis (10,24).

Other researchers have documented increased anxiety among women with false-positive mammograms (6–12,25–32), with anxiety lasting from less than 1 month (9) to as long as 3 years after the screening mammogram (30). The consistency of this finding [15 of 16 studies reviewed in (33)] across many different settings indicates that broad populations could benefit from strategies to reduce the anxiety associated with false-positive mammograms.

Few studies have evaluated approaches to decrease women's anxieties after receiving an abnormal mammogram reading, including those that involve immediate reading of mammograms. Lindfors et al. (34) found that women who completed follow-up evaluations the same day they had an abnormal mammogram reported less stress 6 weeks after the abnormal mammogram than did women who completed the follow-up evaluations later. However, that study was limited by the retrospective assessment of stress and by the use of a single-item 5-point Likert scale as the measure by which the stress of the overall experience was reported. Haas et al. (35) surveyed women with abnormal mammograms 6–8 weeks after the mammogram and found that anxiety levels did not differ with the length of time from the mammogram to the first follow-up test; however, these investigators did not report results for same-day versus different-day follow-up.



Very little research has focused on educational interventions to reduce women's anxieties after receiving an abnormal mammogram. In 1994, Austoker and Ong (36) reported that women who received an informational leaflet with their recall letter found the specific information about the recall process in the leaflet to be reassuring and that the women better understood why they were recalled than did women who did not receive a leaflet with their recall letter. The same authors subsequently surveyed more than 2100 women who were recalled for further evaluation and found that women from mammography centers where counseling by nurses was available were less likely to have unanswered questions about the reason for their recall and about the tests that were performed on them (37).

Our study has several strengths. First, we were able to study a radiology intervention by taking advantage of a natural experiment, in which immediate reading of mammograms was implemented on a part-time basis. Second, our study took place in a large multispecialty group practice in which mammography use is very high (38). Third, our study had a high participation rate: Participation in both the 3-week and the 3-month telephone interviews was greater than 75%. Our study has several limitations. First, the main outcome assessment measure, the generic IES, displayed a "floor effect," such that 52% of women with false-positive mammograms reported no anxiety, and thus it may have been insensitive to mammogram-related anxiety. Second, the women who participated in our study had a high education level and thus may not be representative of other populations because more highly educated women have been shown to be less likely to report having anxiety about the results of their mammograms than are women with low education levels (39). Third, the recall rate among the women in our study was relatively high [almost 20%, compared with recall rates of approximately 11% in nationwide samples (4)], which may reflect a different threshold for recommending extra views in this setting. A potential consequence of a setting with a high recall rate is that technologists might assuage women's anxieties immediately by offering reassurances because abnormal mammograms are so common. Finally, the size of our study sample limited our ability to examine subgroups of women who might have benefited from the educational intervention. However, none of these limitations could substantially alter our finding of a positive effect of the radiology intervention.

Our findings indicate that women with abnormal mammograms who receive an immediate radiology review of their mammograms have less anxiety about the mammogram than do women who do not receive immediate radiology review. The benefits of immediate radiology review potentially apply to many women because false-positive mammograms are common, especially among women who have repeated screens. However, the benefit-to-cost ratio of immediate radiology review must be assessed because changes to established radiology systems can be costly. The challenge is to provide the best-quality care for women undergoing mammography screening by maximizing the benefits associated with a timely diagnosis of cancer and minimizing the harms of screening, including anxiety caused by false-positive mammograms.

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## NOTES

Supported by Public Health Service grant 1 RO1 CA72570 to S. W. Fletcher from the National Cancer Institute, National Institutes of Health, Department of Health and Human Services, and by the Harvard Pilgrim Health Care Foundation. Dr. Philip Arena, Lynn Bergquist, and Elizabeth Hardy of the Harvard Vanguard Medical Associates Radiology Department made the study possible by making the radiology units and records available and encouraging all personnel to participate.

We thank all the mammography technologists who participated for their valuable assistance.

Manuscript received June 2, 2003; revised November 28, 2003; accepted February 5, 2004.