

## Family Breast Cancer History and Mammography

### Framingham Offspring Study

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The authors examined mammography use according to family cancer history and identified predictors of recent use ( $\leq 2$  years). Framingham Offspring Study participants in Framingham, Massachusetts, aged 40–79 years, completed a breast health questionnaire in 1996–1997. The study sample of women included 141 with a first-degree relative with breast cancer, 221 with a mother or sister(s) with other cancers, and 331 with a mother and sister(s) who participate in the Framingham Heart Study and did not report a history of cancer. Stepwise logistic regression analysis was used to identify predictors of recent mammography use. Among women with a family breast cancer history, 98% reported mammography use compared with 95% of other women. Recent mammography use was higher in women with a family breast cancer history (93%) compared with women with a family history of other cancer (80%) and women without a family history of cancer (84%) ( $p = 0.004$ ). Odds ratios and 95% confidence intervals for significant predictors of recent mammography use were as follows: family history of breast cancer, 3.2 (95% confidence interval (CI): 1.4, 7.7); recent clinical breast examination, 17.4 (95% CI: 9.2, 32.8); and smoking, 0.4 (95% CI: 0.2, 0.7). Mammography use was high among women with a family breast cancer history. *Am J Epidemiol* 2001;154:916–23.

family characteristics; mammography; smoking

A family history of breast cancer is associated with a woman's risk of developing the disease, and the risk is of the greatest magnitude when a first-degree relative is affected (1, 2). Early detection with screening mammography is effective in significantly decreasing breast cancer mortality (3, 4). Among women aged 40 years or older with a family history of breast cancer, a higher proportion who have abnormal mammograms actually have underlying breast cancer compared with women without a family history of the disease (5). Despite the benefits associated with screening, women who report a family history of breast cancer do not appear to have substantially different screening histories than women in the general population (6, 7). Further understanding of screening practices and factors associated with mammography use are needed.

We surveyed a population-based sample of women in Framingham, Massachusetts, participating in the

Framingham Offspring Study regarding their use of breast cancer screening modalities. Because of the unique multigenerational design of the Framingham Heart Study (FHS) and ongoing ascertainment of cancer among participants, we were able to identify women who had mothers or sisters with documented breast cancer. Our study goals were to describe mammography use by women according to family cancer history and to identify predictors of recent mammography use.

## MATERIALS AND METHODS

### Study sample

The FHS was established in 1948, with enrollment including 2,873 women aged 28–62 years. Children of the original cohort and their spouses were recruited in 1971 to form the Offspring cohort of the FHS and included 2,641 women aged 5–67 years. Members of the original cohort have undergone biennial examination, while the Offspring cohort has been examined every 3–4 years since study inception. Offspring women aged 40 years or older were eligible for this study. Informed consent was obtained from study participants when they were examined. The institutional review board of the Boston Medical Center (Boston, Massachusetts) approved the examination content. At each routine examination, major illnesses were reported, including cancer. Two independent reviewers evaluated records for all cancer cases identified through September 1996. Fewer than 1 percent of the cases of cancer were based on clinical diagnoses or death certificate data without corroborating microscopic confirmation.

Received for publication December 6, 2000, and accepted for publication June 26, 2001.

Abbreviations: CBE, clinical breast examination; CI, confidence interval; FHS, Framingham Heart Study.

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At the time of this study, 154 cancer-free women in the Offspring cohort had a mother or sister participating in the FHS who had documented breast cancer. An additional 289 Offspring women had a mother or sister in the FHS with documented cancer other than breast or gynecologic cancer (nonmelanoma skin cancers were excluded). Of Offspring women with neither a mother nor a sister(s) in the FHS with cancer, 486 were randomly selected and were age-group matched to serve as a comparison group to those women with a family history of breast cancer.

An FHS breast health questionnaire was developed, which was based on the 1994 Massachusetts Behavioral Risk Factor Surveillance System Instrument and the National Health Interview Survey Cancer Screening Knowledge and Practice instrument, to obtain information on mammography use. Included were queries about ever use, lifetime number of mammograms, recent use, age at first use, and age-group-specific frequency of use. Women were asked their main reason for having a mammogram and were required to choose all reasons that applied from among the following: 1) part of a routine check-up, 2) to clarify a breast problem, 3) to manage a known history of breast cancer, 4) strong family history of breast cancer, and 5) other. We also asked women to specify who decided to have the mammogram (woman requested the mammogram, physician recommended the mammogram, other). Self-reports of clinical breast examination (CBE) and performance of breast self-examination, personal history of benign breast disease and breast surgery, and perceived risk of breast cancer were obtained. Specific information was requested to verify knowledge of the family member's diagnosis of breast cancer and to identify women who had family members with breast cancer who were not FHS participants.

From July 1996 to May 1997, each woman received a mailed questionnaire. Overall, 76.5 percent of the women returned the questionnaire. Of these women, 9 were excluded because they were younger than age 40 years, and 12 were excluded because of mastectomy, ductal carcinoma in situ, or a personal history of breast cancer diagnosed after their last visit to the Framingham Offspring Study research clinic. An additional woman was excluded after reporting having an adopted daughter with breast cancer. Six women were unaware of their family member's diagnosis of breast cancer. Because these six women with an actual family history of breast cancer did not perceive themselves as having such a history, they were excluded from the study. Twenty-six women reported having a sister or daughter diagnosed with breast cancer who was not participating in the FHS. Although we could not confirm these breast cancer cases, these women were included among those with a family history of breast cancer. Our final study sample included 141 women with a mother, sister, or daughter with breast cancer; 211 women with a mother or sister known to have cancer other than breast cancer or gynecologic cancer; and 331 women with a mother and sister(s) who participated in the FHS and did not report a history of cancer.

#### Framingham examination data

At each follow-up research examination, participants were queried about their use of routine check-ups and ill-

nesses requiring a physician visit. Marital status was recorded, and women were asked about their use of oral contraceptives as well as their smoking status, alcohol intake, and subjective health. Height and weight were measured by using standardized protocols. Data from the last cycle of examinations (1991–1995) completed prior to the mailed breast health questionnaire were used, with the exception of oral contraceptive use, for which data from all prior examinations attended were used. Educational status was recorded only once, at follow-up examination 2 (1979–1982).

#### Statistical analysis

The prevalence of ever and recent use of mammography was calculated, and the chi-square test was used to evaluate differences in use between women with and without a family history of breast cancer. Age-adjusted logistic regression analysis identified factors associated with recent mammography use. Potential predictor variables included recent CBE, CBE ever, performance of breast self-examination, self-reported breast disorder, self-reported breast surgery, age at first childbirth, age at menarche, oral contraceptive use, smoking, alcohol intake, use of routine check-ups, physician visits prompted by illness, marital status, education, subjective health, and self-perceived risk of breast cancer. Stepwise logistic regression analysis was used to select the most parsimonious model from among the significant predictors found. This set of covariates was used to adjust for confounding in multivariable logistic regression analysis of the association between family history of breast cancer and recent mammography use.

#### RESULTS

The majority of women in the study sample were married and were residents of Massachusetts (table 1). Their mean age was 59 years, less than 20 percent of the women smoked, and 85 percent or more had reported at least one routine check-up with their personal physician at the time of their last research examination. More than half of the women reported being employed; however, only 13 percent of women with a family history of breast cancer, 7 percent of women with a family history of other cancer, and 12 percent of women without a family history of cancer reported professional occupations. Less than 2 percent of the women were unemployed. There were no differences in any of these characteristics between women with and without a family history of breast cancer.

Self-reported mammography use by our study sample was exceedingly high. Among women with a first-degree relative with breast cancer, 98 percent had ever had a mammogram, while 95 percent of women with a mother or sister with cancer other than breast cancer and 95 percent of women with a mother and sister(s) free of breast cancer had had at least one mammogram (table 2). Among women with a family breast cancer history, 93 percent reported having had a mammogram within the past 2 years, a rate significantly higher than that for recent mammography use by

**TABLE 1. Characteristics of Framingham Offspring Study women according to female family history of cancer, Framingham, Massachusetts, 1996–1997\***

	Family history of breast cancer ( <i>n</i> = 141)	Family history of other cancer ( <i>n</i> = 221)	No family history of cancer ( <i>n</i> = 331)	All women ( <i>n</i> = 683)
Mean age (years)	60	60	58	59
Massachusetts resident (%)	74	72	69	71
Employment (%)				
Working	50	48	57	53
Homemaker	35	33	24	29
Retired	4	7	4	5
Unemployed	0	1	1	1
Unknown	11	11	14	12
Married (%)	72	69	69	70
Smoker (%)	17	17	17	17
Use of routine check-ups (%)	85	87	88	87

\* No differences were found between women with a family history of breast cancer and those without such a history.

women with a family history of other cancer (80 percent) and women without a family cancer history (84 percent) ( $p = 0.004$ ). This difference was observed for all decades of age but was most marked for younger women. Recent mammography use by women with a family breast cancer history was reported by 92 percent of women aged 40–49 years, 96 percent of women aged 50–59 years, 92 percent of women aged 60–69 years, and 86 percent of women aged 70 years or older. Correspondingly, 69 percent of women aged 40–49 years, 86 percent of women aged 50–59 years, 87 percent of women aged 60–69 years, and 77 percent of women aged 70 years or older without a family history of breast cancer reported recent mammography use.

Because there were no differences in mammography use in the two groups of women without a family history of breast cancer, the groups were combined for further analy-

ses. When women without a family history of breast cancer were compared with women with such a history, 91 versus 84 percent reported that one of the main reasons for the mammogram was that it was part of a routine check-up. Only 33 percent of women with a family history stated that the mammogram was performed because of a strong family history of breast cancer. Three quarters of all women reported that the mammogram was performed because of a physician's recommendation.

Use of CBE did not differ significantly according to family history of breast cancer (table 2). Among women with a family breast cancer history, 92 percent reported a recent ( $\leq 2$  years) CBE compared with 86 percent of women with a family history of other cancer and 91 percent of women without a family cancer history. CBE use did not decline with mammography use, because 96 percent of women

**TABLE 2. Breast cancer screening use (%) according to female family history of cancer, Framingham Offspring Study, Framingham, Massachusetts, 1996–1997**

	Family history of breast cancer ( <i>n</i> = 141)	Family history of other cancer ( <i>n</i> = 221)	No family history of cancer ( <i>n</i> = 331)
Mammogram ever	98	95	95
Recent mammogram* ( $\leq 2$ years)	93	80	84
Recent clinical breast examination†	92	86	91
At least monthly breast self-examination†	63	58	60

\*  $p = 0.004$ .

† 27 women did not report information on clinical breast examination, and 91 women did not report information on breast self-examination.

mentioning a recent mammogram also reported a recent CBE. Among women who did not report a recent mammogram, 55 percent mentioned a recent CBE. Additionally, among the small number of women who had never undergone mammography screening, 86 percent reported having ever had a CBE, and 60 percent stated that they had had a CBE within the past 2 years. Among women with a family breast cancer history, 63 percent performed breast self-examination once per month or more often compared with 58 percent of women with a family history of other cancer and 60 percent of women without a family cancer history.

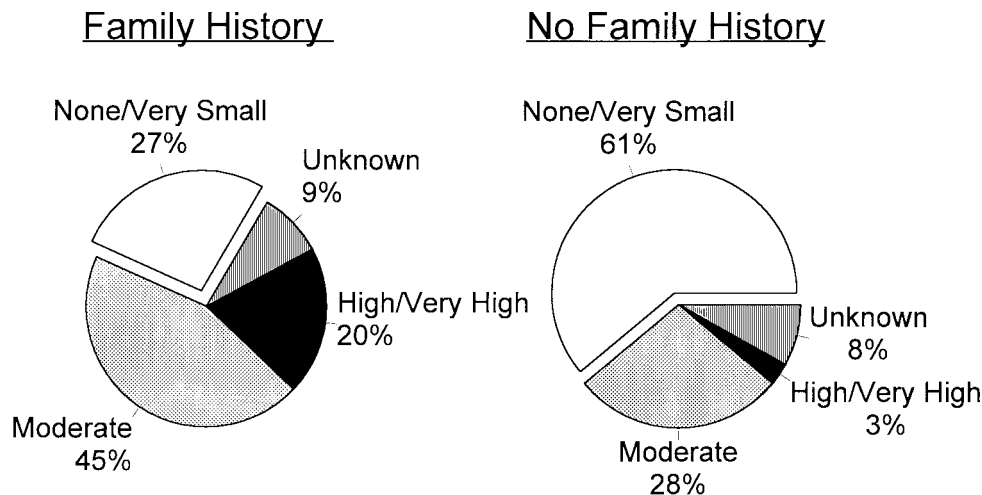
Women were asked to rank their self-perceived lifetime risk of breast cancer as none, very small, moderate, high, or very high. Among women with a family breast cancer history, 27 percent perceived their risk as none to very small compared with 61 percent of women without a family breast cancer history (figure 1). Recent mammography use (within the past 2 years) remained high irrespective of self-perceived breast cancer risk in women with a family breast cancer history. However, for women without a family breast cancer history, recent mammography use increased from 74 percent for those who reported their breast cancer risk as none to 93 percent for those reporting their breast cancer risk as high to very high ( $p = 0.06$ ).

Age-adjusted analyses identified multiple predictors of recent mammography use for women in our study sample. Recent CBE, CBE ever, current smoking, self-perceived risk of breast cancer, alcohol intake, self-reported breast disorder, and use of routine check-ups were all significantly associated with recent mammography use (table 3). Performance of breast self-examination, age at first birth, age at menarche, history of oral contraceptive use, marital status, education, subjective health, and physician visits for illness were not associated with recent use. Stepwise logistic regression analyses using the significant variables from age-adjusted analyses determined that recent CBE and smoking status were covariates for multivariable analysis (table 4). Women with a family history of breast cancer were

three times more likely than women without such a history to have had a recent mammogram (odds ratio = 3.2, 95 percent confidence interval (CI): 1.4, 7.7). Having a recent CBE increased the likelihood of having a recent mammogram 17-fold (95 percent CI: 9.2, 32.8), while being a smoker was associated with a 62 percent reduction in recent mammography use (odds ratio = 0.38, 95 percent CI: 0.21, 0.71).

## DISCUSSION

Almost all of the women in our study sample, irrespective of family breast cancer history, had undergone mammography at least once. However, recent mammography use was lower than ever use and was significantly higher among women with a family breast cancer history than among women without such a history. Our data extend previous reports showing substantial improvements in mammography use from the late 1980s to the early 1990s. Nationally representative surveys conducted in 1992 reported that 67–74 percent of women had had a mammogram (8–11). A national sample of women with health insurance coverage surveyed in 1996–1997, the same time period as our study, demonstrated a further improvement in the prevalence of ever use of mammography (65 percent use in 1991–1992 vs. 71 percent use in 1996–1997) (12). A 1997 survey found that the total age-adjusted proportion of women aged 40 years or older who reported ever having a mammogram was 85 percent (13), a prevalence closer to the 95–98 percent ever use reported by women in this study. The higher usage reported in our study sample may be due to greater health awareness from participating in a longitudinal research study, regional variation in mammography use in the United States, and preventive health care use (over 85 percent of women in our study reported a routine check-up). A survey of physicians and their patients derived from a random selection of community primary care practices in New Hampshire and Vermont found that 71 percent of women



**FIGURE 1.** Self-perceived lifetime risk of breast cancer in women with and without a family history of breast cancer, Framingham Offspring Study, Framingham, Massachusetts, 1996–1997.

**TABLE 3. Age-adjusted predictors of recent mammography use by Framingham Offspring Study women aged 40–79 years, Framingham, Massachusetts, 1996–1997**

Predictor	Odds ratio	95% confidence interval	p value
Recent clinical breast examination	21.0	11.5, 38.3	0.0001
Clinical breast examination ever	6.0	1.9, 18.6	0.002
Breast self-examination	1.4	0.8, 2.4	0.19
Self-perceived risk of breast cancer*	1.6	1.0, 2.6	0.04
Self-reported breast disorder	1.8	1.1, 3.1	0.03
Self-reported breast surgery	1.1	0.6, 1.9	0.77
Routine check-up	3.0	1.7, 5.2	0.0001
Physician visit for illness	1.0	0.6, 1.6	0.98
Marital status	1.4	0.9, 2.2	0.17
Education†	1.0	0.6, 1.6	0.85
Subjective health status‡	0.8	0.3, 2.4	0.72
Current smoker	0.3	0.2, 0.6	0.0001
Alcohol intake (yes/no)	1.7	1.1, 2.6	0.03
Age at first birth ≥ 30 years	0.6	0.3, 1.2	0.15
Age at menarche ≥ 15 years	1.0	0.5, 2.1	0.92
Use of oral contraceptives	1.4	0.8, 2.2	0.22

\* Moderate, high, or very high compared with none or very low.

† College compared with lower educational level.

‡ Good or excellent compared with fair or poor.

**TABLE 4. Predictors of recent mammography use: results from multivariable logistic regression analysis, Framingham Offspring Study, Framingham, Massachusetts, 1996–1997**

Predictor	Odds ratio	95% confidence interval
Family history of breast cancer*	3.2	1.4, 7.7
Recent (≤ 2 years) clinical breast examination†	17.4	9.2, 32.8
Current smoker‡	0.38	0.21, 0.71

\* Exposure of interest.

† Covariates were selected by using stepwise logistic regression; variables available for selection included age, recent clinical breast examination, clinical breast examination ever, current smoking, perceived risk of breast cancer, alcohol intake, breast disorder, and use of routine check-ups.

reported having a periodic health examination in the past year (14). Furthermore, mammography use in the past year was significantly higher among women reporting periodic health examination compared with women without such examination (14).

Trends in recent mammography use have paralleled the increase in ever use of mammography (8, 9, 12, 15–17).

National surveys have consistently reported a doubling in recent use, with continued gains made throughout the 1990s, so that 1997 national survey data demonstrated 71 percent of women reporting a recent mammogram (12, 13). Our findings of lower recent use compared with ever use of mammography are consistent with national surveys and raise concerns that women who undergo an initial mammogram are not returning for repeat screening.

Many early reports failed to find an association between family history of breast cancer and increased use of mammography (6, 7, 15, 18). More recent surveys of Medicare-insured older women in eastern Massachusetts found greater increases in recent mammography use in the 2-year period 1991–1993 by women with a family history than by women without one (19). However, recent mammography use by these older women with positive family histories remained far below optimal screening goals (19, 20). Between 25 and 35 percent of older women with positive family histories did not have a mammogram in the past 2 years (19), and only 63 percent of women aged 50 years or older with a family history of breast cancer adhered to age-specific mammography screening guidelines (20). In our sample, recent mammography use by women with a family history was both significantly higher than use by women without such a history and, although not 100 percent, approached optimal screening.

In contrast to other reports, we did not observe a decline in CBE use among women receiving mammography (21). Among women reporting a recent mammogram, 96 percent also mentioned a recent CBE. This finding is important because breast cancers can elude mammography. CBE alone detects from 3 to 45 percent of breast cancers found that were missed by mammography (22).

National surveys have identified several important barriers to mammography use, including older age, low income, lower educational level, lack of health insurance, and lack of a usual source of health care (8, 10, 11, 15, 17, 23–26). Our study identified additional predictors of recent mammography use: recent CBE, family breast cancer history, and non-smoking status (smokers were less likely to have had a mammogram). CBE represents a time for the physician to discuss breast cancer screening modalities and recommend mammography. Population-based surveys of women have demonstrated that a lack of physician recommendation was consistently reported as an important deterrent to having a mammogram (11, 15). An analysis of the relation between the information source and mammography use suggested that physicians, as sources of information, motivated women to have a mammogram (27). Despite the strong evidence linking mammography use and physician recommendation, a recent survey of women aged 40 years or older who reported a routine physical examination in the past 2 years found that one quarter of these women could not recall a health care provider discussing mammography with them (28).

A physician assessment of family history, breast cancer risk factors, and education on personal breast cancer risk may enhance adherence with mammography recommendations. Many investigators have found that knowledge of risk factors (for example, increasing risk of breast cancer after age 50 years) and self-perceived vulnerability to developing breast cancer were positively associated with screening behaviors (6, 29–31). However, data have been conflicting on the impact of anxiety and greater worry on screening (20, 29, 30, 32, 33). It is unclear whether women who are educated about their risk status will avoid mammography because of fear or will be more likely to comply with guidelines. Although some studies have reported that anxiety decreased the likelihood of repeat participation or adherence to mammography screening (20, 29), others have shown that greater worry enhanced screening (30). Investigators examining screening behaviors in women with a family history of breast cancer, who understood that this history increased their risk for breast cancer, did not find that anxiety was responsible for the lack of increased screening in these women compared with women without such a history (32). Knowledge of the recommended screening guidelines for one's age and the belief that breast cancer can be cured have also been positively associated with screening adherence (34). These findings taken together suggest that physicians should educate women on not only the importance of family history and other breast cancer risk factors but also the need for repeat screening according to guidelines. In an effort to alleviate fears associated with risk status, the benefits of early detection of

breast cancer through mammography screening should be included in the physician-patient discussion.

When personal risk is discussed with patients, care needs to be taken to avoid reducing mammography adherence by women who perceive themselves to be at high risk for breast cancer but who are informed that their risk is actually lower. Women with a family history of breast cancer were randomized to a breast cancer risk counseling intervention or a general health education control intervention; among the less-educated women, those receiving the risk counseling intervention had used mammography less frequently 1 year later than women in the general education group (35). The investigators noted that the majority of women overestimated their breast cancer risk at baseline, and they suggested that the less-educated women may have misunderstood the lower personal risk estimates, which in turn may have undermined their motivation to continue mammography screening. Only 43 percent of eligible women participated in the prior trial, possibly resulting in selection of more health-conscious and motivated women. Future work is needed to more fully understand the possible untoward effects of counseling on mammography use.

Smokers in our study sample were 60 percent less likely than nonsmokers to have had a recent mammogram. Other investigators have also found smoking to be associated with a lack of recent mammography use (23, 24, 36, 37). In accordance with our results, smokers in both the 1995 Maryland Behavioral Risk Factor Survey and the 1990–1994 National Health Interview Surveys had significantly lower recent mammography rates compared with nonsmokers (36, 37). Smoking status may identify a group of women who are less likely to pursue health maintenance strategies such as mammography. This possibility is of concern because, although controversial, findings from several case-control studies have raised the hypothesis that active and passive smoke exposure may increase the risk of developing breast cancer (38–43).

Our study was limited by reliance on self-report of mammography use. However, self-report has been used extensively in multiple, nationally representative surveys of mammography screening. It has been shown to be a valid measure of whether a woman has ever had a mammogram and whether the mammogram was performed in the past year (44, 45). The response rate for the mammography questionnaire did not differ by family history group (80 percent of women with a family history of breast cancer, 79 percent of women with a family history of other cancer, and 74 percent of women with no reported family history of cancer returned the questionnaire). Additionally, FHS participants are predominantly White, reflecting the demographics of the town of Framingham, Massachusetts, in 1948 when the study was initiated. Therefore, our findings cannot be generalized to women of color.

Mammography use was exceedingly high for all women in our study sample. Recent mammography use was significantly higher among women with a family breast cancer history than among women without one. Recent use was lower than ever use of mammography, raising concerns that women are not undergoing repeat mammography screening

as often as recommended by national guidelines. Strategies to improve recent mammography use should include assessment of family breast cancer history, education reflecting currently recognized breast cancer risk factors, and discussion of the benefits of detecting breast cancer early through mammography screening to alleviate any fears associated with knowing one's risk status. CBE represents an important opportunity for physicians to discuss breast cancer screening and to recommend mammography. Furthermore, initiatives are needed to improve mammography use among women who smoke.

## ACKNOWLEDGMENTS

This work was supported by a pilot project grant from the Department of Medicine at Boston Medical Center and by a Massachusetts Breast Cancer Research Program grant from the Massachusetts Department of Public Health. The National Heart, Lung, and Blood Institute's (NHLBI) Framingham Heart Study is supported by National Institutes of Health/NHLBI contract NO1-HC-38083.

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