Breast Self-Examination Proficiency and Training Effects: Women at Increased Risk of Breast Cancer

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Abstract
While breast self-examination (BSE) frequency has received extensive research attention, proficiency has been less frequently addressed. Moreover, BSE proficiency among women at increased risk has not been adequately examined. Assessment of BSE proficiency is critical in determining the value of BSE with mammography and clinical breast examination in the early detection of breast cancer.

BSE proficiency was assessed in 101 first-degree relatives of breast cancer patients. Participants were stratified by BSE frequency and randomized to one of two training techniques (MammaCare or concentric circle). BSE performance was assessed at baseline and at three follow-up visits at 4-month intervals. Proficiency was assessed by verbal description, a projected grid observational method, and lump detection ability on two breast models. BSE frequency was also assessed, in addition to BSE confidence, knowledge of breast cancer, risk perception, and worry related to breast cancer development.

At baseline, proficiency was poor and correlations were not significant across assessment modalities. Significant improvement occurred on self-report measures, lump detection ability (true positives) on both models, and the projected grid. Improvement occurred across both training groups by the first follow-up, with no changes at subsequent visits. Both training techniques significantly improved BSE proficiency and were viewed positively by participants.

Introduction
Current American Cancer Society guidelines regarding breast cancer screening include monthly BSE in women 20 years of age and older (1). Despite reports questioning the value of BSE as a screening test (2, 3), several studies have demonstrated that women who perform BSE detect breast cancer at an earlier stage of disease (4, 5). In addition, a recent metaanalysis of studies investigating breast self-exam and extent of disease found evidence for the benefit of breast self-examination (6). Thus, monthly BSE may be an important component of breast cancer screening as an adjunct to regular clinical breast exams and mammography. A recent consensus conference on breast cancer screening (2) recommended targeting women at increased risk of breast cancer for investigations assessing the efficacy of breast self-examination. One clearly established risk factor for breast cancer is an affected first-degree relative (mother, sister, daughter). Despite this increased risk, only 30-40% of women with a family history of breast cancer report monthly BSE (7). This figure is not different from the BSE frequency among women without a family history (8, 9). A number of studies indicate that few women perform the steps generally defined as necessary for a proficient exam (2, 9). Studies both supporting (10, 11) and not supporting (12-14) the value of BSE often have not comprehensively assessed proficiency. Despite these reports of poor BSE proficiency, investigations have supported the ability of BSE training interventions to improve BSE proficiency measured by both procedural aspects of BSE (15) or lump detection criteria (16).

The recent U.S. Preventive Services Task Force (2) noted the need to assess the effect of various teaching techniques on the proficiency and frequency of BSE and the need to target appropriate populations for BSE research. This study addresses these needs, including targeting women at increased risk for developing breast cancer, i.e., first-degree female relatives of breast cancer patients. This study was a stratified, randomized, two-armed clinical trial designed to measure the proficiency of BSE across two training conditions. Two types of BSE training were compared: (a) the MammaCare method, which includes a vertical strip search pattern; and (b) the concentric circle method, which involves palpating breast tissue in a pattern of smaller circles, finishing at the areola complex.

There have been no investigations to date specifically addressing comprehensive BSE proficiency in women at increased risk for breast cancer. In addition, little is known about the relative efficacy of different BSE training techniques or the relationship across different BSE assessment modalities (e.g., verbal description, lump detection in breast models) (2). Data from the baseline visit of this study have been reported (17). Baseline proficiency was poor across assessment modalities in this sample of women at increased risk. This report includes data indicating whether one type of BSE instruction (concentric circle or MammaCare) was superior across assessment modalities among women aware of their increased risk as a function of family history.
Materials and Methods

Subjects. Inclusion criteria included: (a) first-degree (mother, sister, daughter) female relatives of patients with breast cancer; (b) an age of ≥20 years; (c) ability to provide informed consent. Women were excluded who had a diagnosis of breast cancer or reported a diagnostic work-up for a breast abnormality at the time of recruitment.

Participants were recruited from two sources over a 12-month period. The Johns Hopkins Tumor Registry provided listings of women with diagnosed breast cancer seen in the Johns Hopkins Oncology Center over a 9-month period (n = 218). These women were contacted for permission to consent their first-degree relatives. One hundred forty-six (146) granted permission and reported 170 first-degree relatives within the metro/suburban area in which the study took place. Eighty-one (81) of these 170 first-degree relatives (48%) agreed to participate. In addition, an advertisement describing the study was placed in a number of circulars generally available to staff at the Johns Hopkins Hospital and the Johns Hopkins University, resulting in 20 additional participants. These methods of recruitment resulted in the total sample size of 101 participants who provided formal informed consent and entered the present investigation. For the silicone model assessment, 31 participants/group were needed to detect a 30% difference between groups on the ability to detect three of five lumps, at a significance level of \( P < 0.05 \), power of 80%. Forty participants were needed per group to reliably detect a 20% difference in percentage of breast tissue palpated (projected grid), with \( P < 0.05 \), power of 80%. Thus, the initial sample size was adequate for the two primary outcome measures to ensure that a significant difference between the training groups would not be missed.

Procedures. Following entry onto the study, participants reported their BSE frequency over the 6 months prior to inclusion in the study. Information on variables selected as predictors of BSE proficiency was also collected (17). Participants were then stratified on frequency of BSE over this 6-month time period (0–3, 4–6) and randomly assigned to one of the two training groups. Following gathering of this information and instruction regarding the family history of breast cancer (number and type of relative affected, laterality, menopausal status), baseline BSE proficiency was assessed. Neither the participants nor the BSE assessor was aware of group assignment until completion of the baseline assessment. Baseline proficiency was assessed by: (a) verbal description of BSE. This self-report was audiotaped and scored on a 0–19 competency scale. This scale has been used in prior investigations of BSE proficiency (15). This assessment included three standard probes: (i) “Please tell me specifically what steps you use when you examine your breasts”; (ii) “Is there any special position you assume?” and (iii) “Is there anything else you do?” This format was chosen to match that used in the 1979 NIH National Survey of Breast Cancer Knowledge, Attitudes, and Practices (18). (b) performance on two silicone models. Nodule detection proficiency in silicone models has been used in prior investigations (19, 20). Training with breast models has been shown to significantly increase the sensitivity of BSE. One investigation found that a 30-min training session with breast models increased mean lump detection in actual breast tissue (lesions = 0.25–3.0 cm) from 25 to 50% (19). One model used in the present study included a MammaCare training model. This model was hemispherical, with one side consisting of an opaque cover containing five lumps of varying size, hardness, and movability embedded against “normal” moderate nodularity (21). Lump sizes ranged from 0.3 to 1.0 cm in diameter. A second breast model, the Health EdCo standard BSE model, commonly used for BSE teaching, is a teardrop-shaped silicone model (22). Embedded in the model are five differing abnormalities which simulate breast lumps. Lump sizes range from approximately 0.5 to 3.0 cm, including a 2.0-cm cluster. Breast cancer diagnosed with tumors 2 cm or less with no regional lymph node metastases are considered Stage I breast cancers. Survival among women with breast cancer diagnosed at this stage may reach 80–90% at 20 years (23). Thus, the ability to detect lumps of this size by BSE may directly impact on survival. Nine of the ten breast lumps across the two models are sizes consistent with Stage I breast cancer.

The third assessment mode consisted of a projected grid score sheet system (20, 21). This method involves positioning an overhead projector so that a numbered grid, consisting of squares 1.0 cm in size, is projected onto the woman’s breasts, with the area encompassed by the grid outlined on a similarly griddared score sheet. Each palpation made by the participant is marked in the corresponding squared score sheet, recording both total number of palpations and total number of squares palpated. This method has demonstrated excellent interobserver reliability (20).

Thus, proficiency assessment utilized self-report, a more elaborate system (the projected grid) assessing specific parameters of the BSE procedure itself (i.e., two “procedural” measures), and two silicone models for lump detection ability (i.e., “outcome” measures).

In addition to the proficiency assessment, all participants were provided with information regarding the goal of BSE, clinical breast exam, and mammography. They were instructed on the course of action to take if an abnormality was detected on BSE and the current recommendations for breast cancer screening (1).

Participants were scheduled to be seen four times at 4-month intervals over the course of the 1-year study period (baseline and three follow-up visits). Following baseline assessments at the first visit, participants were trained in either the concentric circle or MammaCare method of BSE.

The MammaCare method of BSE incorporates silicone models to teach discrimination between small masses and normal nodularity of surrounding breast tissue and use of palpation and search techniques to contact the maximum proportion of breast tissue. The procedures involved in BSE training began with a 40-min video, watched with the nurse who paused the tape to practice concurrently with presented material. The training continued with visual inspection assessing breast symmetry, contour, color, shape, and skin integrity performed in front of a mirror. Palpation with the flats of the middle three fingers to make three small circles with three varying pressures (light, medium, deep touch) at each point of contact was performed in a vertical strip search pattern, first taught on the silicone MammaCare model. When the participant identified at least three of...
the five lumps successfully, the pattern was transferred to the participant’s actual breast tissue, beginning in the axilla and moving vertically at about one palpation per inch down to just below the bra line in the posterior axillary line. Each point of palpation generated three dime-to-quarter-sized circles of varying pressures (one each at light, medium, and deep pressures). When the bra line was reached, the palpation pattern moved medially about 1 inch and up from the bra line to the humeral head, over about 1 inch and down to the bra line, etc. Thus, “boundaries” of the perimeter of the breast area examined by the MammaCare method extend from the clavicle/humeral head to just below the bra line and from the posterior axillary line to the midsternum, creating a large rectangular surface. Finally, each MammaCare participant was provided with a MammaCare model to utilize for monthly BSE prior to actual BSE performance.

The basic techniques associated with the concentric circle method of training include: (a) visual inspection, assessing breast symmetry, contour, color, shape, and skin integrity performed in front of a mirror; (b) palpation of breast and lymph node areas, assessing for abnormal thickening and masses while lying down with breast flattened against the chest wall using the right hand to exam the left breast, and vice versa. Palpation (quarter-sized motions) were performed with the flats of the middle three fingers beginning at the 12:00 position at the top of the breast and moving fingers in a clockwise fashion, palpating once at each point corresponding to an hour interval. Palpations moved inward toward the nipple at increasingly smaller concentric circles. The actual teaching methods began with a 7-min videotape from the American Cancer Society demonstrating the technique. This videotape was watched with the nurse, who paused the tape so that practice occurred concurrently with presented material. The concentric circle group had access to a Spenco breast model which they could palpate if they chose. This brief option was included since the presence of this model is not uncommon when learning “standard” BSE. There was no specific training on this model. The model was examined while placed on a table or the woman’s thigh (patient’s choice). Participants then practiced the concentric circle technique on one breast with active guidance from the nurse practitioner. Finally, each participant demonstrated BSE on the other breast, with feedback as needed from the nurse practitioner. Critical, distinguishing procedural aspects between the two techniques include: (a) MammaCare incorporates teaching of BSE on silicone breast models prior to instruction on actual breast tissue; (b) the search pattern differs (vertical strip versus circular search); (c) MammaCare utilizes more extensive videotape instruction with hierarchial, structured behavioral steps; (d) as a function of the models and video, MammaCare requires more time to teach and more time to perform BSE; (e) three palpations at each examination point are involved in MammaCare training (light, medium, deep) versus one palpation at each examination point for the concentric circle method.

All participants were scheduled for 4-, 8-, and 12-month follow-up visits. Participants were provided with self-report forms in self-addressed, stamped envelopes at each visit including baseline, to return monthly, indicating whether BSE was performed and to provide any information on BSE findings. At the 4- and 8-month follow-ups, the verbal description and silicone model assessments were completed, self-report forms reviewed, and questions answered about BSE procedures. The follow-up visits were assessment visits, with no formal BSE training or feedback provided unless participants had specific questions regarding BSE performance. In addition, at the 12-month follow-up, the projected grid measure was utilized, and specific BSE feedback was provided to participants following assessment.

The BSE proficiency assessments were completed by a clinical adult nurse practitioner with 18 years’ experience teaching breast self-examination. This nurse practitioner also received MammaCare specialist training (which includes training specifically in the projected grid assessment). The participants’ verbal description of BSE was audiorecorded and scored by a research assistant. Twenty-five % of these samples across assessment intervals were randomly selected and scored by the first author for reliability purposes, with acceptable interrater reliability (κ = 0.76). As noted, the projected grid measure has been found to have excellent interobserver reliability (20) and the model assessment involved simply noting the number of lumps detected and the location of the lumps within the model.

**Results**

Table 1 presents descriptive data on women participating in the study. There were no significant differences between training groups on the variables listed. In addition, there was no difference in the total number of relatives
Breast Self-Examination Proficiency and Training Effects

Table 2 Baseline proficiency assessment

<table>
<thead>
<tr>
<th></th>
<th>Concentric circle (n = 51)</th>
<th>MammaCare (n = 50)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X ± SD</td>
<td>X ± SD</td>
</tr>
<tr>
<td>No. of palpations + no. of squares available</td>
<td>0.52 ± 0.1-1.0</td>
<td>0.21 ± 0.49-1.0</td>
</tr>
<tr>
<td>No. of palpations + no. of squares examined</td>
<td>1.39 ± 1.0-2.1</td>
<td>0.90 ± 1.25-1.28</td>
</tr>
<tr>
<td>Verbal descriptions (0-19)</td>
<td>5.10 ± 0-11</td>
<td>3.98 ± 4.56-0-11</td>
</tr>
<tr>
<td>MammaCare model</td>
<td>1.08 ± 0-5</td>
<td>1.65 ± 1.35-0-5</td>
</tr>
<tr>
<td>Health EdCo model</td>
<td>3.46 ± 0-5</td>
<td>1.68 ± 3.29-0-5</td>
</tr>
</tbody>
</table>

* This value can range from 0.0 (no breast surface area palpated) to 1.0 (entire breast tissue surface palpated).

* Recommended number of palpations per square examined = 3.

(first and second degree) or in the total number of first-degree relatives with breast cancer.

MammaCare training involves a behavioral shaping strategy of training requiring an extensive training/practice investment. Thus, it was expected that MammaCare would require more training time at the baseline session. This was confirmed, with MammaCare training requiring 52.8 min (SD = 15.2) versus 27.0 min (SD = 7.28) for the concentric circle training. Differences across groups on baseline questionnaire items were examined that might impact upon breast self-examination competence and/or frequency. There were no baseline differences between groups on the belief that BSE is effective in early detection of breast cancer or ability to detect breast cancer, intent to perform breast self-examination over the subsequent 6 months, perception of risk, and worry related to breast cancer development.

The number of total participants attending the baseline training session (n = 101) decreased at the 4-month (n = 86), 8-month (n = 75), and 12-month (n = 61) follow-ups. Thus, while attrition was minimal at session 2 (14%), the total attrition rate from baseline to session 4 (12-month visit) was 39%. There was no significant differential attrition between the two training groups. In addition, there was no significant difference on verbal description, lump detection, or projected grid performance outcome measures at the baseline session between study adherers and dropouts.

**Baseline Proficiency.** Table 2 presents baseline performance on the proficiency assessments. As noted in our prior report (17), proficiency across assessments was poor. There was no significant between-training group difference at baseline on either MammaCare or Health EdCo lump detection (in true positives or false positives) performance.

**BSE Training Effects.** Participants were requested to complete four BSE monthly examination forms to return in self-addressed, stamped envelopes monthly between visits. This form indicated whether BSE had been performed and whether any changes had been noted. By session 2 (4 months), 68.5% of participants reported BSE monthly in the 3 months between study visits. The average number of forms returned by the 8-month follow-up visit by participants was 6.82, while the average number returned by participants remaining at the 12-month follow-up visit was 8.56. Frequency was not significantly different between training groups, nor was there a significant difference in the number of forms returned among participants completing the study versus dropouts at the follow-up visit preceding attrition.

A 2 (training) x 4 (sessions) analysis of variance was completed on proficiency measures, including verbal description, MammaCare and Health EdCo silicone model true positives and false positives. A 2 (training) x 2 (sessions) was completed on the projected grid measures (number of squares examined + squares available; number of palpations; number of palpations + number of squares examined). Table 3 notes those differences determined to be significant in BSE proficiency across sessions. There were no significant training main effects or training x session interactions. Significant session main effects were found on verbal description (f = 4.61; P < 0.001), MammaCare true positives (f = 7.3; P < 0.001), MammaCare false positives (f = 7.3; P < 0.001), Health EdCo true positives (f = 63.2; P < 0.001), and projected grid measures (f = 74.7; P < 0.001) (completed at baseline and session 4 only). As noted in Table 3, significant improvement across these measures occurred at session 2 (4-month follow-up) with maintenance of improvement at sessions 3 and 4 (8 and 12 months). No significant differences occurred between session 2 and sessions 3 and 4 on any BSE proficiency outcome measure. One analysis of interest involved the number of participants able to detect the three largest lumps on each model (0.6-1.0 cm on the MammaCare model; 1.0-3.0 cm on the Health EdCo model). For the Health EdCo model, detection of three lumps or more was similar between MammaCare and concentric circle training groups at session 1 (i.e., baseline) (78% versus 73%), session 2 (89% versus 87%), session 3 (95% versus 97%), and session 4 (100% versus 97%). No statistically significant differences were found between the two training groups. However, the differences noted with the MammaCare model may be of interest and are shown in Table 4.
Overall, confidence in BSE significantly increased from session 1 to session 2 ($t = 3.19; P < 0.05$) across both training groups. Confidence at sessions 2, 3, and 4 did not correlate with any BSE proficiency outcome measure. At study completion (session 4), participants reported on 7-point Likert scales that their training was a “good way to learn BSE” ($x = 5.95; SD = 1.58$) and that they were satisfied with their BSE training ($x = 4.93; SD = 1.38$). There were no significant between-group differences on these measures.

### Discussion

This study compared two commonly used BSE training techniques to detect differences on BSE examination frequency, proficiency as measured by a number of different assessment modalities, and “consumer” satisfaction with the assigned teaching method (MammaCare or concentric circle). Overall, baseline proficiency across assessment modalities (verbal description, lump detection on silicone breast models, amount of breast surface palpated) was poor. The implications of this poor proficiency are discussed more extensively elsewhere (17). In addition, the two training techniques (MammaCare versus concentric circle) were generally effective and equally so in teaching women at increased risk to perform BSE more proficiently. There were no significant differences between training groups on confidence in performing BSE or satisfaction with BSE training received. There was a significant session effect, with significant changes on BSE proficiency measures of verbal description, MammaCare silicone model true positives and false positives, Health EdCo silicone model true positives, and amount of breast surface palpated as measured by the projected grid assessment (number of squares examined + number of squares available). All significant effects were evidenced by the first follow-up session (4 months postbaseline) and maintained at sessions 3 and 4. Thus, a baseline training session and one follow-up session for observation and refinement may be adequate for most women at increased risk of developing breast cancer to learn a proficient BSE. This finding may have relevance for the attrition rate found in the present study (32%). Specifically, no differences were found in age, number of first-degree relatives, type of teaching received, proficiency at baseline, or prestudy BSE frequency to explain the high attrition rate. It may simply be that women received BSE teaching, reported increased confidence in BSE, were further evaluated at session 2, and did not perceive a need for sessions 3 and 4. As noted, proficiency improvements occurred by session 2, which included 86% of participants initially enrolled. Thus, while session 4 results may lack sufficient power for strong conclusions regarding treatment group differences, this is not true for proficiency assessed during sessions 2 and 3. Moreover, absolute differences across proficiency measure scores at session 4 between training groups are minimal.

In the absence of a randomized trial to determine a definition of BSE proficiency related to increased survival, how do we clinically determine “proficient” BSE as assessed by lump detection performance? Should women be taught until all five lumps in the silicone breast models can be detected consistently? Stage I breast cancer includes tumors 2.0 cm or less in greatest dimension. Significantly, breast cancer metastases correlate directly with tumor size (23, 24). While tumor size alone has limited predictiveness for lymph node involvement, approximately 65–75% of all tumors less than 2.0 cm have negative axillary node involvement, which is directly linked to increased survival (23). In addition, tumor doubling time is a concept perhaps useful in determining minimal standards of BSE proficiency. Some evidence exists that the amount of time required for breast cancer to double in size may occur quite rapidly in early breast cancer ($x = 25$ days) or significantly slower ($x = 129$ days) in later breast tumors (24). For this reason, it may be preferable to utilize a model with smaller lumps such as the MammaCare model (0.3–1.0 cm). With models containing lumps of this size range, assuming an inability to detect an abnormality at a given BSE, successful palpation at a second monthly BSE would still potentially allow detection at a Stage I level even with an aggressive breast cancer. That is, a 1.0-cm undetected lump at a given BSE with a rapid doubling time (e.g., 25 days) would allow a favorable chance of detection of breast cancer at Stage I at the subsequent monthly BSE. Obviously, metastases can occur as often as 20–30% of the time with tumors as small as 0.1–0.5 cm. However, considering the likelihood of false positives and benign biopsies among younger women (25), the possibility of decreased BSE practice with findings of false positives (26), and some evidence of increased false positives with the MammaCare model in the present study, three of five lumps (0.6–1.0 cm) detected consistently with the MammaCare models may be a reasonable goal for BSE “proficiency,” with adequate breast surface coverage. Given the risk of breast cancer among women 20–30 years old (roughly 0.02–0.05% in this decade), the issue of false positives is of some concern. Psychological sequelae and adherence to screening recommendations following a false-positive screening is still somewhat unclear (27, 28). It should be noted that the above argument assumes transfer of BSE lump detection skills from silicone models to actual breast tissue, an assumption with some support (19).

Confidence in BSE performance was not correlated with BSE proficiency measures, although it was significantly related to reports of BSE frequency preintervention.

The lack of between-training-group differences on satisfaction with the type of teaching method received is not an indication that individual preferences may not exist. This study did not examine predictors of satisfaction, nor did it expose women to each technique for their selection of preferred method. However, given the equivalent training effects and briefer training involved with the concentric circle intervention, it seems reasonable to recommend the latter. Other study limitations include the sample selected, i.e., women at increased risk of breast cancer who were further evaluated at sessions 2, and did not perceive a need for sessions 3 and 4.
risk. The study findings may apply only to women who perceive their risk as increased and who may differ in motivation or other ways from women not aware of their increased risk. This study also does not address the issue of which, if any, BSE procedure is optimal for women reporting extreme anxiety related to BSE.

Finally, a number of studies investigating breast cancer survival related to BSE practice have been equivocal (2–5). Many of these investigations have used BSE frequency or verbal description of BSE proficiency to predict survival. It appears clear that BSE frequency cannot be used interchangeably with BSE proficiency and that comprehensive BSE proficiency must be assessed in studies investigating the efficacy of BSE as an adjunct screening measure to clinical breast exam and mammography in the early detection of breast cancer.

References

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