Association of New-Onset Breast Discomfort With an Increase in Mammographic Density During Hormone Therapy

Carolyn J. Crandall, MD, MS; Arun Karlamangla, MD, PhD; Mei-Hua Huang, DrPH; Giske Ursin, PhD; Min Guan, MS; Gail A. Greendale, MD

**Background:** Postmenopausal use of estrogen and progesterin therapy increases breast density and breast discomfort. Whether this increase in breast density is heralded by new-onset breast discomfort is unknown.

**Methods:** We used data from the Postmenopausal Estrogen/Progestin Interventions Mammographic Density Study, which retrieved and examined baseline and 12-month mammograms for 594 (67.9%) of 875 women aged 45 to 64 years enrolled in the randomized controlled trial. Treatments included placebo, 0.625 mg/d of conjugated equine estrogens, 0.625 mg/d of conjugated equine estrogens and medroxyprogesterone acetate (10 mg/d for 12 d/mo or 2.5 mg/d continuously), or 0.625 mg/d of conjugated equine estrogens and 200 mg/d of micronized progesterin for 12 d/mo. Breast density (the percent of the breast composed of dense tissue) was calculated from digitized mammograms obtained at baseline and at 12-month follow-up. Breast discomfort was ascertained at baseline and at follow-up using standardized self-report questionnaires. In bivariate analysis, and then in multivariable linear regression models, we assessed the association between change in percent breast density from baseline to 12-month follow-up and new-onset breast discomfort in participants who had no breast discomfort at baseline (N = 533).

**Results:** After adjustment for age, treatment assignment (placebo, conjugated equine estrogens, or progestin-containing regimen), and other potential confounders, women with new-onset breast discomfort had a 3.9% increase in percent breast density compared with a 0.6% increase in percent breast density among women without new-onset breast discomfort (β = .033, P < .001). The association between incident breast discomfort and increased percent breast density was similar in all active treatment arms.

**Conclusion:** In postmenopausal women randomly assigned to menopausal hormone therapy vs placebo, new-onset breast discomfort is associated with increased mammographic density.

Arch Intern Med. 2006;166:1578-1584

**HIGH ENDOGENOUSLY OCCURRING mammographic density (ie, that which occurs in the absence of pharmacological stimulus) is a well-established, strong, independent risk factor for breast cancer.1,3 Women with dense tissue in more than 75% of the breast have a 4-fold higher risk of developing breast cancer compared with women with little or no density in the breast.2,4 In ranking the importance of known risk factors for breast cancer, the American Cancer Society5 includes high breast density in the highest risk category.

Increase in breast density is a known effect of combined (estrogen and progesterin) hormone therapy (HT).5,6 Whether the gain in breast density that results from combination HT signals an increase in breast cancer risk remains unknown.

Breast discomfort is another effect of menopausal HT. Whereas the natural history of breast discomfort is to decrease with the menopausal transition,7,8 results of the Postmenopausal Estrogen/Progestin Interventions (PEPI) trial9 and other randomized controlled trials10,11 demonstrate that breast discomfort increases with administration of combined estrogen and progesterin therapy.

Results of prior studies12,13 suggest that new-onset breast discomfort during menopausal HT increased breast density, but causal inference is inconclusive because of study limitations. In both of these studies, HT assignment was nonrandomized, and participants were unblinded to treatment.

We examined the association between new-onset breast discomfort during 12 months of HT administration and increase in percent breast density during the same period. We used data from the PEPI Mammographic Density Study (PEPI-MDS), a longitudinal study of the deter-
minimants of mammographic density and change in mammographic density in women receiving vs those not receiving menopausal HT.5,14-16

METHODS

PARTICIPANTS

Data for this analysis came from the PEPI-MDS, an independent study initiated after the PEPI trial was completed. The PEPI trial design has been described in detail.1 In brief, the PEPI trial was a double-blind, randomized, controlled trial designed to compare the effects of placebo and several regimens of orally administered menopausal HT on cardiovascular disease risk factors in postmenopausal women recruited between December 27, 1989, and February 8, 1991, by the following 7 participating centers: George Washington University, Washington, DC; The Johns Hopkins University, Baltimore, Md; Stanford University, Stanford, Calif; University of California, Los Angeles; University of California, San Diego; University of Iowa, Iowa City; and University of Texas Health Science Center, San Antonio. The treatment regimens were placebo (placebo arm), 0.625 mg/d of conjugated equine estrogens (CEE arm), 0.625 mg/d of conjugated estrogens and 10 mg/d of medroxyprogesterone acetate for 12 d/mo (CEE and cyclical MPA arm), 0.625 mg/d of conjugated equine estrogens and 2.5 mg/d of medroxyprogesterone acetate continuously (CEE and continuous MPA arm), or 0.625 mg/d of conjugated equine estrogens and 200 mg/d of micronized progesterin for 12 d/mo (CEE and MP arm). The 875 PEPI trial participants (of 1557 women screened) had to be between 45 and 64 years old and had been menopausal for at least 1 year at enrollment into the trial. Women with any contraindication to the use of combined estrogen or progesterin therapy (eg, breast cancer) were excluded.17

The PEPI-MDS was designed to elucidate hormonal, genetic, and lifestyle determinants of breast density. Of 875 PEPI trial participants, 603 had retrievable baseline mammograms. Of these, 7 women had breast implants and 2 women’s mammograms were technically inadequate. As a result of these exclusions, mammograms from 594 women (67.9% of 875 women in the PEPI trial) were examined in the PEPI-MDS.5,14-16

Fifty-two of 594 women in the PEPI-MDS had reported breast discomfort at baseline and were excluded from the present study. An additional 9 women were excluded because breast discomfort information was unavailable for them at 12-month follow-up, leaving us with an analytic sample size of 533.

MEASUREMENTS

Information about age, ethnicity, cigarette smoking, alcohol use, physical activity level, parity, ethnicity, prior hysterectomy, years since menopause, and presence of breast discomfort came from standardized self-report questionnaires.17 The following specific questions regarding breast discomfort were asked at baseline and at 12-month follow-up: “During the past week including today, did any of these symptoms bother you or interfere with your life? Breast sensitivity/tenderness (yes or no), painful breasts (yes or no).” We classified women who reported breast sensitivity/tenderness (yes or no) and/or painful breasts (yes or no) as having breast discomfort. Weight and height were measured at baseline.17 Compliance with treatment was defined as having taken at least 80% of study medication at 6-month and 12-month follow-up visits, verified by pill count.

The serum estrone level was measured from fasting blood samples drawn at baseline and at 12-month follow-up and was analyzed using radioimmunoassay as previously described.18 Interassay and intra-assay coefficients of variation for serum estrone were 15% and 16%, respectively. The lower limit of detection of the estrone assay was 3 pg/mL.

Prrandomization conventional craniocaudal mammograms obtained between 1989 and 1994 during the original PEPI study were retrieved from the 7 participating PEPI trial clinical centers. Percent breast density was quantified by a single reader (G.L.U.) as the percent of the breast image that was composed of dense tissue using methods detailed previously.5,18 In brief, mammograms were digitized at a resolution of 150 pixels per square inch. Breast tissue was outlined on the digitized mammogram image by the reader; next, the reader established for each image a density threshold above which breast tissue was to be considered dense and a density threshold below which breast tissue was to be considered nondense. The software calculated percent breast density as the ratio of the total area of dense breast tissue in the image to the total area of the breast tissue. Reasons for exclusion included the presence of breast implants or technical inadequacy such as excessively dark images that precluded the reader’s ability to define the breast and to set a density threshold. The intrarater reliability for percent breast density was high: intraclass correlation coefficients were greater than 0.95 for mammograms that were rated as not difficult to read or as slightly difficult to read, and greater than 0.91 for mammograms that were difficult to read or very difficult to read (as judged by the reader).19 Previous findings have documented the high interrater reliability of this technique for breast density assessment.19

STATISTICAL ANALYSIS

We compared key demographic and lifestyle-related characteristics of the analytic sample with those of the remainder of the PEPI trial participants using t test (continuous variables) or χ2 test (categorical variables). Because baseline percent breast density was not normally distributed, we compared baseline percent breast density in women who had baseline breast discomfort vs those who did not have baseline breast discomfort using Wilcoxon rank sum test.

In the longitudinal sample of 533 women without baseline breast discomfort, we compared the mean 12-month change in percent breast density in women who had new-onset breast discomfort vs those who did not have new-onset breast discomfort using t test. We then adjusted for potential confounders using a multivariable linear regression model with change in percent breast density as the outcome and incident breast discomfort (yes or no) as the main predictor. The incidence of new-onset breast discomfort and the 12-month change in percent breast density were similar among women assigned to the 3 progesterin-containing regimens. Therefore, we grouped the progesterin arms and included treatment arm as a 3-level covariate composed of placebo, CEE alone, and any progesterin-containing regimens. We also included pill compliance as a covariate. Other covariates for the regression models, chosen on the basis of prior publications, biological plausibility, and statistical considerations, included current smoking (yes or no),20 ethnicity (white vs nonwhite),21-25 age (continuous),2,26 number of pregnancies resulting in live births (continuous), age at first pregnancy (continuous),20,22,27,28 body mass index (continuous),20,22,23,27-30 alcohol consumption (continuous),28 and log-transformed baseline percent breast density.

We considered potential interactions by adding interaction terms to the linear regression models containing these covariates. To assess the statistical significance of each interaction term, we evaluated the P values for the interaction term in the linear regression model. Interaction terms were dropped from the model if P>.10 for tests of significance. Four poten-
density was not normally distributed, values are given as median (IQR).

In secondary analyses, we added baseline level during menopausal combined estrogen and progestin therapy. Therefore, in secondary analyses, we added baseline level during menopausal combined estrogen and progestin therapy. We added baseline level during menopausal combined estrogen and progestin therapy.

Hypothetical interactions were tested. First, to assess whether the relation between incident breast discomfort and increase in percent breast density was different according to treatment arm, we included a treatment assignment–new-onset breast discomfort interaction term. Second, to address the possibility that the association between new-onset breast discomfort and change in mammographic density could be stronger in women who were compliant with treatment assignment, we tested for compliance–new-onset breast discomfort interaction. Third, we tested for compliance–new-onset breast discomfort interaction.

Fourth, to determine whether the association between new-onset breast discomfort and change in percent breast density is modified by recent HT use (ie, quitting hormones to join the PEPI trial), we added an interaction term (recent hormone use–new-onset breast discomfort) to the linear regression model containing the covariates.

The PEPI-MDS previously reported that change in percent breast density was related to the magnitude of change in estrone level during menopausal combined estrogen and progestin therapy. Therefore, in secondary analyses, we added baseline estrone level and change in percent breast density to the model to assess whether the new-onset breast discomfort–change in percent breast density link was mediated by change in estrone level.

DESCRIPTIVE STATISTICS

The 533 participants included in the present analysis were similar to the rest of the PEPI trial participants for variables of interest (Table 1). Participants in the analytic sample were on average 56.1 years old and had been menopausal for 5.6 years. Most were white and nonsmokers. These women were also similar to the 61 PEPI-MDS participants who were excluded on the basis of baseline breast discomfort. Most (52 of 61 participants) had baseline breast discomfort. Most (52 of 61 participants) had baseline breast discomfort. Most (52 of 61 participants) had baseline breast discomfort.

Table 1. Baseline Characteristics of the Analytic Sample Compared With Those of the Excluded PEPI-MDS Participantsa

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Remainder of PEPI-MDS Participants (n = 61)b</th>
<th>Excluded Because of Baseline Breast Discomfort (n = 61)</th>
<th>Remainder of Excluded Participants (n = 281)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>56.1 ± 4.3</td>
<td>55.0 ± 4.3</td>
<td>56.2 ± 4.3</td>
</tr>
<tr>
<td>Years since menopausec</td>
<td>5.6 ± 2.7</td>
<td>5.6 ± 2.8</td>
<td>5.7 ± 2.8</td>
</tr>
<tr>
<td>Body mass indexd</td>
<td>26.0 ± 4.5</td>
<td>27.9 ± 4.3</td>
<td>25.6 ± 4.3</td>
</tr>
<tr>
<td>Prior use of hormone therapye</td>
<td>295 (55.3)</td>
<td>34 (55.7)</td>
<td>163 (58.0)</td>
</tr>
<tr>
<td>Recency of hormone therapy use, m/</td>
<td>25.4 ± 46.9</td>
<td>18.7 ± 31.5</td>
<td>26.3 ± 55.0</td>
</tr>
<tr>
<td>Smoking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>69 (12.9)</td>
<td>8 (13.1)</td>
<td>41 (14.6)</td>
</tr>
<tr>
<td>Former</td>
<td>202 (37.9)</td>
<td>23 (37.7)</td>
<td>100 (35.6)</td>
</tr>
<tr>
<td>Never</td>
<td>262 (49.2)</td>
<td>30 (49.2)</td>
<td>140 (49.8)</td>
</tr>
<tr>
<td>Alcohol use, g/d</td>
<td>6.5 ± 12.2</td>
<td>5.3 ± 14.1</td>
<td>6.9 ± 11.5</td>
</tr>
<tr>
<td>Level of physical activitye</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>362 (67.9)</td>
<td>38 (62.3)</td>
<td>175 (62.3)</td>
</tr>
<tr>
<td>Medium</td>
<td>166 (31.1)</td>
<td>23 (37.7)</td>
<td>105 (37.4)</td>
</tr>
<tr>
<td>High</td>
<td>5 (0.9)</td>
<td>0</td>
<td>1 (0.4)</td>
</tr>
<tr>
<td>Nonwhite ethnicity</td>
<td>62 (11.6)</td>
<td>10 (16.4)</td>
<td>28 (10.0)</td>
</tr>
<tr>
<td>Compliance with treatment assignmentf</td>
<td>467 (87.6)</td>
<td>52 (85.2)</td>
<td>230 (81.9)</td>
</tr>
<tr>
<td>Uncertain menopausei</td>
<td>123 (23.1)</td>
<td>19 (31.1)</td>
<td>78 (27.8)</td>
</tr>
<tr>
<td>Hysterectomyj</td>
<td>154 (28.9)</td>
<td>25 (41.0)</td>
<td>100 (35.6)</td>
</tr>
<tr>
<td>Baseline % breast density, median (IQR)h</td>
<td>23.8 (28.0)</td>
<td>19.0 (30.4)</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

Abbreviations: IQR, interquartile range; PEPI-MDS, Postmenopausal Estrogen/Progestin Interventions Mammographic Density Study.

aMost (52 of 61 participants) had baseline breast discomfort.

bData are given as mean ± SD or as number (percent) unless otherwise indicated.

cThe last menstrual period for women who had a hysterectomy with bilateral oophorectomy was considered to be the date of the hysterectomy. Because of some missing answers, sample sizes for years since menopause were 36 (women with baseline breast discomfort), 417 (women without baseline breast discomfort), and 204 (remainder of PEPI-MDS participants).

dCalculated as weight in kilograms divided by the square of height in meters.

eWomen were allowed to enroll in the PEPI-MDS trial if they discontinued menopausal hormone therapy for at least 2 months before the first screening visit.

RESULTS

The 533 participants included in the present analysis were similar to the rest of the PEPI trial participants for variables of interest (Table 1). Participants in the analytic sample were on average 56.1 years old and had been menopausal for 5.6 years. Most were white and nonsmokers. These women were also similar to the 61 PEPI-MDS participants who were excluded on the basis of baseline breast discomfort (n=52) or lack of follow-up discomfort information (n=9). A higher proportion of the 61 excluded...
women had prior hysterectomy compared with participants included in our analytic sample. The median baseline percent breast density did not differ between the 2 groups (19.0% in the excluded group vs 23.8% in the analytic sample; \(P = .13\), Wilcoxon rank sum test).

The overall group median percent breast density at baseline was 23.6% (interquartile range, 28.1%). The baseline percent breast density was similar by treatment arm \((P = .97\), analysis of variance test of difference by treatment arm\). The prevalence of breast discomfort at baseline was also similar among treatment arms \((range, 7.6\% - 9.7\%\); \(P = .98\), \(\chi^2\) test of difference by treatment arms\).

In the 533 women in our analytic sample, the incidence of new-onset breast discomfort at 12-month follow-up was 21.2%. The incidence differed statistically among treatment arms: 12.5%, 14.8%, 28.0%, 23.2%, and 27.5%, respectively, in the placebo arm, CEE arm, CEE and cyclical MPA arm, CEE and continuous MPA arm, and CEE and MP arm \((P = .01\), overall \(\chi^2\) test\) \(\textbf{(Figure 1)}\).

Compared with the placebo and CEE-only arms, in which the risks of new-onset breast discomfort were 12.5% and 14.8%, respectively, the risks in the 3 progestin-containing arms were about double \((range, 23.2\% - 28.0\%)\) \(\textbf{(Figure 1)}\) \((range, P = .04\) to \(P = .006\) for comparison of the 3 progestin-containing arms with the placebo arm and \(P = .02\) to \(P = .11\) for comparison of the 3 progestin-containing arms with the CEE alone arm\). The occurrence of new-onset breast discomfort did not differ significantly among the 3 progestin-containing arms \((range, P = .42\) to \(P = .96\) for pairwise comparisons\). The occurrence of new-onset breast discomfort was 26.2% in the aggregated progestin-containing arms, significantly higher than that in the CEE-only arm \((P = .02)\) and in the placebo arm \((P < .01)\), as demonstrated in a prior PEPI study.\(^9\)

The incidence of new-onset breast discomfort in the CEE-only arm was not statistically different from that in the placebo arm \((P = .62)\).

The mean ± SD 12-month increase in percent breast density \(12\)-month percent breast density minus baseline percent breast density) was \(2.7\% ± 8.7\%\). \textbf{Figure 2} shows that at 12 months the percent breast density had decreased 0.4% in the placebo arm and had increased in the CEE arm \((0.9\%)\), CEE and cyclical MPA arm \((4.6\%)\), CEE and continuous MPA arm \((4.4\%)\), and CEE and MP arm \((3.1\%)\). The mean change in percent breast density was not different among the 3 progestin-containing arms \((P = .68)\). Taken as a single group, the change in percent breast density was 4.0% in the progestin-containing arms, and this was significantly higher than that in the CEE-only arm \((P = .001)\) and in the placebo arm \((P < .001)\). The change in percent breast density in the CEE-only arm was not significantly higher than that in the placebo arm \((P = .25)\).

**UNADJUSTED AND ADJUSTED PRIMARY ASSOCIATION**

The mean change in percent breast density was higher in women who had new-onset breast discomfort vs those who did not have new-onset breast discomfort \(5.4\%\) vs \(1.8\%\), \(P < .001\). After adjustment for parity, age at baseline, age at first pregnancy, body mass index, alcohol intake, smoking, ethnicity, baseline percent breast density, compliance with treatment in a linear regression model, and treatment arm assignment \(\text{(placebo, CEE-only, or progestin-containing regimens)}\), women with new-onset breast discomfort had a 3.5% increase in percent breast density compared with a 0.2% increase in women without new-onset breast discomfort \((\beta = .033, P < .001)\).
We next added a treatment assignment–compliance interaction term to the linear regression model. After inclusion of the treatment assignment–compliance interaction term in the model, women with new-onset breast discomfort had a 3.9% increase in percent breast density compared with a 0.6% increase in percent breast density among women without new-onset breast discomfort ($\beta=.333, P<.001$) (Table 2).

The compliance–new-onset breast discomfort interaction was statistically nonsignificant ($P=.32$), indicating that compliance with treatment did not affect the association between new-onset breast discomfort and change in percent breast density. Therefore, this interaction term was omitted from the final model. Recent use of HT before joining the PEPI trial also did not affect the association between new-onset breast discomfort and change in percent breast density ($P=.42$ for the interaction term, $P=.033$ without the interaction term and $P=.036$ with the interaction term).

The treatment assignment–new-onset breast discomfort interaction term was of borderline statistical significance ($P=.15$) with reference to our predesignated interaction term cutoff ($P<.1$). The inability to detect effect modification by treatment arm might reflect the small treatment arm sizes and not a true uniformity of the association between new-onset breast discomfort and increase in percent breast density across treatment arms.

Figure 3 shows the mean change in percent breast density in women who had new-onset breast discomfort vs those who did not have new-onset breast discomfort before and after stratification by treatment arm. Although the effect of new-onset breast discomfort on increase in percent breast density seemed to be markedly greater in women assigned to progestin-containing therapies, this trend was statistically nonsignificant ($P=.15$, test of effect modification by treatment arm).

**Table 2. Association Between New-Onset Breast Discomfort and Change in Percentage Breast Density**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Effect of Predictor on Change in % Breast Density</th>
<th>SE of Change</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>New-onset breast discomfort†</td>
<td>3.3</td>
<td>1.0</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Log-transformed baseline percent breast density</td>
<td>−13.2</td>
<td>3.3</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Age</td>
<td>0.2</td>
<td>0.1</td>
<td>.03</td>
</tr>
<tr>
<td>Parity</td>
<td>0.2</td>
<td>0.1</td>
<td>.09</td>
</tr>
<tr>
<td>Body mass index</td>
<td>&lt;0.1</td>
<td>0.1</td>
<td>.98</td>
</tr>
<tr>
<td>Alcohol use</td>
<td>0.8</td>
<td>0.3</td>
<td>.02</td>
</tr>
<tr>
<td>Smoking</td>
<td>−1.9</td>
<td>1.2</td>
<td>.10</td>
</tr>
<tr>
<td>White ethnicity</td>
<td>0.1</td>
<td>1.2</td>
<td>.92</td>
</tr>
<tr>
<td>Compliance with treatment assignment</td>
<td>−1.5</td>
<td>2.3</td>
<td>.50</td>
</tr>
<tr>
<td>Progestin-containing therapy vs placebo</td>
<td>5.1</td>
<td>1.1</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Conjugated equine estrogens only therapy vs placebo</td>
<td>1.4</td>
<td>1.3</td>
<td>.28</td>
</tr>
</tbody>
</table>

*Percentage of the breast that is dense, as determined using the semiautomated interactive threshold method by Ursin et al. $^{18}$
†The mean change in percent breast density was 3.9% for women with new-onset breast discomfort and 0.6% for women without new-onset breast discomfort.
SECONDARY EXPLORATORY ANALYSIS

In secondary analyses designed to explore whether the relation between incident breast discomfort and change in percent breast density was mediated by the increase in estrone level during postmenopausal HT, we added baseline estrone level and change in estrone level to the final linear regression model. Although change in estrone level significantly predicted change in percent breast density (P = .01), new-onset breast discomfort remained a significant predictor of change in percent breast density (β = .030, P < .01).

The primary research question of this study was “Does new-onset breast discomfort herald increased percent breast density?” Our findings suggest that the answer is yes. The results of 2 previous studies\(^2\) suggest a link between HT-induced breast discomfort and increased breast density; however, these studies were nonrandomized and unblinded. The lack of blinding is a particularly important limitation because breast discomfort data are self-reported.

If increased mammographic density during HT is indicative of increased breast cancer risk, new-onset breast discomfort during HT may be a marker of increased risk of breast cancer. While the PEPI-MDS showed that estrogen and progestin therapy increases mammographic density,\(^3\) the present analysis shows that new-onset breast discomfort provides additional independent information that distinguishes women who experience greater increases in percent breast density during HT.

Neither the magnitude of the association between incident breast discomfort and increase in percent breast density, nor the statistical significance of this association, was altered by adjustment for baseline estrone level and change in estrone level. This observation underscores the importance of considering the possible roles of growth factors, sex hormone–binding globulin, and other estrogens, estrone metabolites, or sex steroids as mediators of this association between new-onset breast discomfort and change in breast density.\(^4\)

The limitations of our study are that it couldn’t capture any breast discomfort that appeared and resolved between the baseline and 12-month assessments and that we did not assess changes in the severity of breast discomfort. Our study also did not allow us to evaluate the chronological sequence (ie, we cannot determine whether the mammographic density change preceded or followed the onset of breast discomfort). The association between new-onset breast discomfort and increase in percent breast density may not be the same for other estrogens and progestins compared to those used in the PEPI trial. Finally, the link between increased breast density in the context of HT use and possible increased risk of breast cancer remains unproven. The strengths of the PEPI-MDS include the high level of participant compliance with assigned therapy, a detailed standardized questionnaire that supplied information about multiple characteristics linked with mammographic density, the best available means of assessing mammographic density, and a prospective, placebo-controlled, randomized, blinded design.

CONCLUSIONS

In postmenopausal women without breast discomfort before the initiation of CEE or CEE and a progestin, new-onset breast discomfort signals increased mammographic density independent of the actual therapy regimen. If increased mammographic density is indicative of increased breast cancer risk during HT, our findings suggest that new-onset breast discomfort during therapy might be a useful clinical marker for increased risk of breast cancer. We expect to test this hypothesis in future studies with breast cancer outcomes. The mechanisms behind HT-associated increases in breast discomfort and mammographic density, and the potential utility of surveillance strategies for women who develop new-onset breast discomfort during menopausal HT, deserve further investigation.

Accepted for Publication: May 11, 2006.

Correspondence: Carolyn J. Crandall, MD, MS, Division of Internal Medicine, The David Geffen School of Medicine at UCLA, University of California, Los Angeles, 911 Broxton Ave, First Floor, Los Angeles, CA 90024 (ccrandall@mednet.ucla.edu).

Author Contributions: Dr Crandall had full access to the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Financial Disclosure: None reported.

Funding/Support: This study was supported by grant 8KB-0035 from the California Breast Cancer Research Program, by grant 5K12AG01004 from the National Institute on Aging, and by grant 2R01 CA077708 (to Dr Greendale) from the National Institutes of Health.

Role of the Sponsors: The funding sources did not participate in the design or conduct of the study; collec-
tion, management, analysis, or interpretation of the data; or preparation, review, or approval of the manuscript. Acknowledgment: We thank the women who generously participated in the PEPI trial.

REFERENCES


**Correction**

Incorrect Total Sample Size Reported in Table 1. In the Original Investigation titled “Association of New-Onset Breast Discomfort With an Increase in Mammographic Density During Hormone Therapy,” by Crandall et al, published in the August 14/28 issue of the *ARCHIVES* (2006;166:1578-1584), the total sample size was incorrectly reported in Table 1 on page 1580. In the column labeled “Remainder of PEPI-MDS Participants,” the value should have been (N=533).