The effect of mammographic screening modalities on the assessment of breast density

By Dr A. Gastounioti

This article summarizes the results of a recent study which investigated the variation in BIRADS breast density as determined visually by radiologists using different screening mammographic modalities. These modalities were digital mammography (DM); digital breast tomosynthesis (DBT) and DM; DBT and synthetic 2D mammograms (SM).

It was found that the assigned breast density category varied greatly depending on the screening imaging method used, with a downward trend of assessed density from DM to DBT to SM.

Women with high breast density have an increased risk of breast cancer and are advised to discuss supplemental screening with their physician. Planar digital mammography (DM) remains the foundation of breast cancer screening. However, the implementation of the quasi-three-dimensional technique of digital breast tomosynthesis (DBT) in breast clinics has meant that the landscape of mammographic screening has been evolving rapidly over the last decade. The use of synthetic mammographic images (SM) derived from tomosynthesis slices as a dose-reduction approach in DBT screening is also contributing to the changes in screening mammography. Because of the rapidity of developments, many aspects of differences in outcomes associated with these different techniques have not been yet fully studied.

In addition to the results of our study which showed a downward trend of assessed density from DM to DBT to SM, we found that differences in breast density assessment as a function of the screening modality used seem to be greater for black than for white women and for groups of women with higher Body-Mass Index (BMI).

The clinical assessment of breast density is becoming increasingly important in determining personalized breast cancer screening regimens. Women with the highest level of breast density have an increased risk of breast cancer [1]. High breast density can also limit the sensitivity of mammography due to masking of tumors [2]. As of now, over 70% of states in the USA have passed legislation mandating that women be notified of their breast density [3]. In some states, women with high breast density are advised to both discuss the implication of their breast density with their healthcare provider and also consider supplemental screening methods. Moreover, a federal law was recently passed requiring the FDA to ensure that every state takes a minimum level of action on making women aware of the increased breast cancer risk associated with dense breasts.

The most commonly used breast density assessment is the American College of Radiology Breast Imaging Reporting and Data System (BIRADS) [4]. The system specifies four categories of breast density:

- a) almost entirely fatty;
- b) scattered fibroglandular densities;
- c) heterogeneously dense;
- d) extremely dense.

Although planar digital mammography (DM) remains the foundation of breast cancer screening, the use of digital breast tomosynthesis (DBT) has been growing rapidly. [5]. This rapid implementation of DBT in breast clinics may also affect the clinical assessment...
of breast density, particularly because practices are increasingly replacing
the conventional DM component in favor of the dose-saving synthetic,
two-dimensional mammographic images (SM) derived from the tomo-
synthesis acquisition [6]. The majority of outcome data regarding the
effect of breast density on screening outcomes and breast cancer risk
assessment has been on the basis of two-dimensional imaging techniques.
Therefore, changes in density assessments derived with tomosynthesis
modalities may affect clinical decisions regarding supplemental screening
and risk assessment before adequate outcome data are available.

In this study [7], we investigated the influence of screening mammographic
modality on clinical breast density assessment by comparing
BI-RADS density assignments after screening by all three major mam-
mographic modalities: DM, DM/DBT and SM/DBT. We looked at the
question of perceived breast density assessment as a function of screening
modality with adjustments for race, age, body mass index (BMI), and indi-
vidual radiologist.

**EFFECT OF SCREENING MAMMOGRAPHIC MODALITY**

In our retrospective study, we ana-
lyzed data from 24,736 individual
women (mean age 56 years) who
underwent from one to seven mam-
mographic screening examinations
at the Hospital of the University of
Pennsylvania (HUP) between 2010
and 2017 (N = 60,766 studies). Data
collected included the breast den-
sity category assigned at the time of
the screening using the standard-
ized BI-RADS system, race, age and
BMI. Major strengths of our study
were the size of our sample and the
diverse screening population which
was 46 percent white and 54 percent
African-American. Of the 60,766
imaging exams included in the study,
8,935 were conducted with DM (14.7
percent), 30,799 (50.7 percent) were
performed with DM/DBT, and 21,052
(34.6 percent) used SM/DBT.

Random-effects logistic regression
analysis was performed to estimate
the odds of being assigned to dense
versus non-dense BI-RADS density
category by each screening modal-
ity, adjusted for race, age, BMI, and
interpreting radiologist. Further-
more, we investigated potential dif-
fences in dense versus non-dense
BI-RADS breast density distributions
by screening modality, separately in
race and BMI groups via tests for
the modality-race and modality-BMI
interactions and stratified statistical
analyses.

We found that breast density
assessment varied greatly as a func-
tion of the screening modality used,
demonstrating a downward trend
from DM to DBT to SM. Compared
to standard DM imaging, the odds
of a high-density assessment were
reduced by 31 percent and 57 per-
cent respectively when mammo-
graphic imaging was performed with DM/DBT or SM/DBT. The odds of receiving a high breast density assignment after SM replaced DM were reduced by 38 percent. Moreover, these effects appear to vary by race and BMI, with changes in breast density assignments as a function of different screening mammographic modalities being greater for black women than for white women and for groups with higher BMI.

Figure 1 shows an example of a post-menopausal white woman who was initially screened with DM/DBT and was assigned BI-RADS density category c (“dense”). A year later the same woman was screened with SM/DBT. Her study was interpreted by the same radiologist who this time assigned breast density category b (“non-dense”).

**DISCUSSION**

Our study shows that the mammographic modality that is used in screening may change the assignment of BI-RADS breast density categories. The observed downward trend of breast density with newer tomosynthesis modalities may be due to the perception of less fibroglandular tissue in the volumetric display of DBT imaging compared to that of planar, area-based density in DM alone imaging, as well as to effects of the reconstructed SM imaging.

If our results are validated by other groups and on a larger scale, and potentially also by readers’ studies involving DM, DM/DBT, and SM/DBT, there could be important clinical implications because of the ramifications of classifying or not classifying an individual woman as having dense breasts. If more women are classified as having non-dense breast tissue, they will not be eligible for supplemental screening. On one hand, health care costs could be decreased by reducing the number of supplemental screening examinations. On the other hand, since studies have consistently shown that additional cancers may be detected with supplemental screening such as by MRI or ultrasound after negative DM or DBT screening, the downgrading of density could result in some of these cancers going undetected. Therefore, supplemental screening may still be warranted in women screened with DBT but may require thresholds to be established based on additional outcome data with longer follow-up.

Considering that densities assessed using DBT and SM differ from those assessed using DM, the role that mammographic breast density plays in risk assessment will potentially also have to be re-examined.

Our study showed that the effect of screening modality on breast density may further vary by race. With racial disparities found also in the age of the onset of breast cancer and in breast cancer outcomes [8], these findings highlight the need for adjusting breast cancer screening guidelines by race, especially in the United States where the population is projected to become more racially and ethnically diverse in the coming years [9]. Further studies with outcome data related to breast density, risk, and race are needed.

It should be noted that this study was performed on the basis of clinical BI-RADS breast density assessments which are subjective. This could be a limitation of our study in that there is a risk of possible variation in reported density as assessed by different radiologists. The results of other studies have shown that the assignment of density categories by radiologists is also affected by the status of the enactment of breast density notification legislation in their states [10].

To address this limitation, we aim to expand our analysis to include automated breast density metrics developed for mammographic screening modalities in order to further elucidate the potential effects of mammographic screening modality in breast density evaluation. Automated breast density methods provide reproducible, quantitative breast density assessment metrics [11].

In summary, our study showed that there were differences in BI-RADS breast density assessment depending on the screening modality used, namely DM, DM/DBT and SM/DBT. Our findings may have direct implications for personalized screening since breast density assignments, which often drive recommendations for supplemental screening, may vary greatly by modality. More rigorous assessment of breast density is needed that will hopefully result in more uniform density designation between modalities, vendors, as well as the race of the women being screened and their risk profiles.

**REFERENCES**