Abstract # 656

# Variation in Diagnostic Imaging Features of Breast Cancer by Race and Ethnicity

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## INTRODUCTION

- Black and Hispanic women are more likely to present with clinically advanced breast cancer at diagnosis compared to White women.[1]
- Black women diagnosed with breast cancer more frequently present with triple-negative disease and have higher mortality rates than their White counterparts.[1,2]
- Imaging and presenting features, such as mammographically occult disease, multifocal/multicentric disease, and breast density are particularly important due to their potential impact on diagnosis and mangaement.[1,3,4,5]
- Less is known about racial and ethnic variability in these diagnostic imaging features and their association with breast cancer outcomes
- Here, we examined variations in imaging features of breast cancer (BC) by race and ethnicity and their association with recurrence free survival (RFS), distant recurrence free survival (DRFS), and overall survival (OS).

## METHODS

- Diagnostic imaging features, clinicopathological characteristics and race and ethnicity information for adult females with a first diagnosis of stage I-III BC during 2016-2023 were obtained from Dana-Farber Cancer Center's prospectively maintained database, the Clinical Outcomes Quality Database, which captures all patients having breast surgery at our high-volume center.
- Occult disease was defined as a lack of detection on diagnostic mammography
- Multifocal or multicentric disease was defined as having this feature on any breast imaging modality — mammogram, MRI, or ultrasound
- Natural language processing (NLP) using ClinicalRegex extracted breast density information (based on standardized breast density codes) from mammogram text files in the electronic health record (EHR).6,7 Only mammograms 1 year prior through 3 months after tumor date of diagnosis were included. For patients with multiple mammograms during the study period, the highest recorded breast density code was selected for final analysis.
- Additional demographics were extracted from the EHR including education and residential zip code, with zip codes used to calculate social deprivation index (SDI)
- Multivariable logistic regression was used to examine racial and ethnic differences in the presence of mammographically occult, multifocal, and multicentric disease as well as breast density, adjusting for age and tumor features
- Cox proportional hazards model evaluated recurrence free survival (RFS), distant recurrence-free survival (DRFS) and overall survival (OS) by race and ethnicity, accounting for clinicopathological, diagnostic, and demographic characteristics.

## RESULTS

**Table 1.** Selected patient clinicopathological, demographic, and diagnostic imaging **characteristics**

| Characteristics | RACE | | | | | ETHNICITY | | | |
|---|---|---|---|---|---|---|---|---|---|
| | *White N=10208* | *Black N=563* | *Asian N=531* | *Other/ Unknown N=496* | *p-value* | *Non-Hispanic N=11031* | *Hispanic N=463* | *Other/ Unknown N=304* | *p-value* |
| **Age at diagnosis Mean (SD)** | 59.2 (13.0) | 56.5 (13.3) | 52.1 (12.9) | 55.9 (12.5) | <0.001 | 58.8 (13.1) | 54.4 (12.7) | 60.7 (11.9) | <0.001 |
| **T stage, %** | | | | | | | | | |
| **T0/Tis/T1** | 71.2 | 61.5 | 63.9 | 62.9 | <0.001 | 71.1 | 63.3 | 78.6 | <0.001 |
| **T2** | 20.1 | 27.0 | 26.7 | 24.6 | | 21.0 | 25.1 | 11.8 | |
| **T3/4** | 6.4 | 9.0 | 6.8 | 9.1 | | 6.7 | 8.5 | 3.3 | |
| **N stage, %** | | | | | | | | | |
| **N0** | 87.6 | 78.0 | 84.9 | 81.7 | <0.001 | 86.8 | 81.4 | 93.4 | <0.001 |
| **N1-3** | 11.6 | 19.9 | 14.2 | 17.3 | | 12.4 | 18.1 | 5.3 | |
| **Histological grade, %** | | | | | | | | | |
| **Grade II** | 42.4 | 36.4 | 45.4 | 41.7 | <0.001 | 42.3 | 41.0 | 39.5 | 0.009 |
| **Grade III** | 31.5 | 47.2 | 32.0 | 39.3 | | 32.4 | 38.9 | 31.3 | |
| **Lymphovascular invasion (LVI) (Yes), %** | 19.4 | 22.7 | 22.5 | 21.1 | 0.101 | 19.8 | 20.8 | 15.7 | 0.23 |
| **Receptor Subtype, %** | | | | | | | | | |
| **HR+/HER2-negative** | 76.3 | 62.6 | 72.4 | 69.7 | <0.001 | 75.3 | 71.1 | 78.3 | 0.032 |
| **HR+/HER2+** | 5.1 | 5.7 | 5.8 | 5.1 | | 5.2 | 4.3 | 4.7 | |
| **HR-/HER2+** | 1.9 | 2.3 | 3.1 | 2.7 | | 1.9 | 3.8 | 3.0 | |
| **Triple negative** | 16.0 | 28.7 | 17.8 | 22.3 | | 16.9 | 20.3 | 13.6 | |
| **Breast density, %** | | | | | | | | | |
| **Almost entirely fatty (1)** | 2.4 | 3.6 | 0.9 | 4.0 | <0.001 | 2.5 | 4.1 | 1.6 | 0.081 |
| **Scattered areas of fibroglandular density (2)** | 28.4 | 41.2 | 14.9 | 28.4 | | 28.3 | 27.4 | 32.6 | |
| **Heterogeneously dense (3)** | 40.3 | 35.2 | 47.8 | 44.4 | | 40.5 | 44.1 | 37.8 | |
| **Extremely dense (4)** | 10.5 | 8.0 | 23.4 | 9.5 | | 11.0 | 11.7 | 7.6 | |
| **Mammographically occult disease (Yes), %** | 5.5 | 4.6 | 4.3 | 5.6 | 0.001 | 5.3 | 8.6 | 5.6 | 0.013 |
| **Multifocal (Yes), %** | 30.3 | 35.7 | 39.0 | 30.0 | <0.001 | 31.0 | 35.0 | 23.7 | 0.004 |
| **Multicentric (Yes), %** | 11.1 | 13.9 | 20.2 | 12.9 | <0.001 | 11.7 | 13.8 | 8.2 | 0.015 |
| **Primage language (English), %** | 97.2 | 91.7 | 82.9 | 65.5 | <0.001 | 96.3 | 63.9 | 95.7 | <0.001 |
| **Highest education level (less than college), %** | 16.3 | 31.4 | 12.6 | 34.5 | <0.001 | 16.7 | 39.3 | 18.4 | <0.001 |
| **Social deprivation index (SDI) (Quintile 5, most deprived), %** | 4.3 | 34.8 | 5.8 | 19.6 | <0.001 | 5.6 | 28.7 | 4.6 | <0.001 |

*Continuous variables were compared across groups using the Kruskal–Wallis test and categorical variables were compared among groups using either Fisher's exact test or the $\chi^2$ test, as appropriate

**Table 2.** Multivariable logistic regression models for diagnostic imaging features

| Characteristics | OUTCOME OF INTEREST: Mammographically occult disease OR (95% CI) N=9620 | p-value | Multifocal disease OR (95% CI) N=9620 | p-value | Multicentric disease OR (95% CI) N=9579 | p-value | Breast density 3-4 vs. 1-2 OR (95% CI) N=7835 | p-value |
|---|---|---|---|---|---|---|---|---|
| **African American vs Caucasian** | 0.91 (0.58-1.36) | 0.664 | 1.18 (0.96,1.44) | 0.108 | 1.05 (0.79,1.38) | 0.735 | 0.49 (0.39,0.61) | **<0.001** |
| **Asian vs Caucasian** | 0.68 (0.42-1.06) | 0.110 | 1.24 (1.01,1.52) | **0.037** | 1.61 (1.25,2.05) | **<0.001** | 1.93 (1.46,2.60) | **<0.001** |
| **Other/Unknown vs Caucasian** | 0.65 (0.38-1.07) | 0.103 | 0.82 (0.64,1.05) | 0.121 | 0.99 (0.70,1.39) | 0.971 | 0.86 (0.64,1.14) | 0.290 |
| **Hispanic vs Non-Hispanic** | 2.05 (1.33-3.08) | **0.001** | 1.24 (0.97,1.59) | 0.089 | 1.03 (0.73,1.44) | 0.867 | 0.92 (0.69,1.25) | 0.603 |
| **Unknown vs Non-Hispanic** | 1.06 (0.55-1.84) | 0.855 | 0.85 (0.62,1.14) | 0.283 | 0.89 (0.55,1.39) | 0.635 | 0.88 (0.64,1.23) | 0.458 |
| **Age at diagnosis** | 0.96 (0.96-0.97) | **<0.001** | 0.98 (0.98,0.98) | **<0.001** | 0.97 (0.97,0.98) | **<0.001** | 0.95 (0.94,0.95) | **<0.001** |
| **T2 vs T0/Tis/T1** | 0.50 (0.39-0.63) | **<0.001** | 1.33 (1.19,1.48) | **<0.001** | 1.75 (1.51,2.04) | **<0.001** | 1.43 (1.26,1.63) | **<0.001** |
| **T3/4 vs T0/Tis/T1** | 0.28 (0.18-0.43) | **<0.001** | 1.17 (0.98,1.39) | 0.090 | 2.89 (2.34,3.56) | **<0.001** | 1.59 (1.27,2.00) | **<0.001** |
| **N1-3 vs N0** | 1.88 (1.43-2.45) | **<0.001** | 1.08 (0.95,1.24) | 0.243 | 1.57 (1.33,1.86) | **<0.001** | 0.83 (0.69,0.98) | **0.031** |
| **Grade II vs I** | 1.00 (0.80-1.27) | 0.972 | 1.49 (1.33,1.67) | **<0.001** | 1.17 (0.98,1.39) | 0.080 | 0.99 (0.88,1.13) | 0.935 |
| **Grade III vs I** | 0.62 (0.46-0.85) | **0.003** | 1.32 (1.15,1.53) | **<0.001** | 0.92 (0.74,1.13) | 0.412 | 0.86 (0.73,1.01) | 0.066 |
| **TNBC vs. HR+HER2-** | 1.90 (1.44-2.49) | **<0.001** | 0.83 (0.73,0.96) | **0.009** | 0.83 (0.69,1.00) | 0.056 | 1.07 (0.91,1.26) | 0.441 |
| **HR-HER2+ vs. HR+HER2-** | 0.59 (0.21-1.34) | 0.265 | 0.98 (0.71,1.33) | 0.889 | 1.21 (0.80,1.78) | 0.363 | 1.44 (0.98,2.16) | 0.066 |
| **HR+HER2+ vs. HR+HER2-** | 0.93 (0.58-1.43) | 0.764 | 0.99 (0.81,1.20) | 0.884 | 0.99 (0.75,1.29) | 0.935 | 0.92 (0.73,1.16) | 0.471 |
| **LVI Yes vs No** | N/A | — | N/A | — | N/A | — | 1.12 (0.98,1.29) | 0.087 |
| **Occult Yes vs No** | N/A | — | N/A | — | N/A | — | 2.76 (2.11,3.67) | **<0.001** |
| **Multifocal Yes vs No** | N/A | — | N/A | — | N/A | — | 1.19 (1.07,1.33) | **0.001** |
| **Multicentric Yes vs No** | N/A | — | N/A | — | N/A | — | 1.57 (1.33,1.86) | **<0.001** |

### Cox Proportional Hazards Models for RFS, DRFS, and OS

- In multivariable regression models, increased age, larger tumor (T2 and T3/T4), nodal disease (N1-3), TNBC, grade III, and the presence of LVI were associated with worse RFS, DRFS, and OS (p<0.01). Higher social deprivation (SDI quintile 4+ 5) were also associated with worse RFS and DRFS (p<0.05)
- There were no racial or ethnic difference in RFS, DRFS or OS after adjusting for clinicopathologic, demographic and diagnostic imaging features
- Mammographically occult disease (RFS HR 1.05; DRFS HR 1.01; OS HR 1.18), multifocal/multicentric disease (RFS HR 1.08; DRFS HR 1.06; OS HR 0.98), or dense breast (breast density 3 or 4) (RFS HR 0.95; DRFS HR 0.82-,0.83; OS HR 0.79, 0.76) were not associated with worse RFS, DRFS or OS (p>0.05) after accounting for clinicopathologic, demographic and diagnostic imaging features

## CONCLUSIONS

- In this unique, large sample of women with breast cancer, we identified racial and ethnic differences in imaging features of breast cancer, particularly among Asian and Hispanic patients.
- Although we observed differences in breast density, multifocality and multicentricity, after adjusting for more traditional features (e.g., subtype), these dissimilarities were not associated with RFS, DRFS or OS and may not be prognostic.
- Longer follow-up is needed to see if accounting for more enhanced diagnostic characteristics impacts outcomes

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**Figure 1.** Kaplan-Meier Curve of RFS by Race

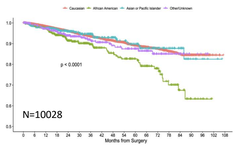



**Figure 2.** Kaplan-Meier Curve of DRFS by Race

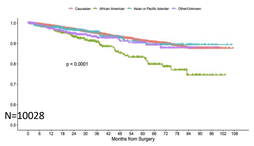
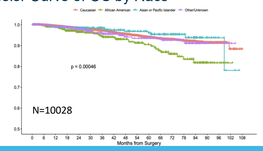



**Figure 3.** Kaplan-Meier Curve of OS by Race




## STRENGTHS & LIMITATIONS

- Strengths of this study include use of a large prospective database with >10,000 invasive episodes and integration of clinical data with demographics from HER
- Limitations include limited numbers of racial and ethnic minoritized patients, mammographically occult designation from diagnostic rather than screening imaging, inability to use NLP on mammograms without an electronic text file in the DFCI/MGB EHR system

## FUTURE DIRECTIONS

- Insurance status at the time of diagnosis, an additional indicator of socioeconomic status, will be incorporated into future analyses to examine racial and ethnic variation in diagnostic imaging features and their relationship to breast cancer outcomes
- Planned analyses of RFS, DRFS and OS by breast cancer subtype, incorporating treatment receipt, to further assess associations of race, ethnicity and diagnostic imaging features with breast cancer outcomes

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