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Knowledge of Breast Density and Awareness of Related Breast Cancer Risk

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Abstract Little is known about women's knowledge of breast density or between-race differences in this knowledge. In the current study, we examined knowledge of breast density and awareness of its role as a breast cancer risk factor among women who had previously taken part in a breast imaging study. Seventy-seven women (54.5 % Black) returned a survey assessing perceptions and accuracy of breast density knowledge, knowledge of one's own breast density, and breast cancer risk awareness. White women had greater perceived knowledge of breast density compared to Black women; however, differences in the accuracy of definitions of breast density were due to education. Black women were less likely to know how dense their own breasts were. Black and White women both lacked awareness that having dense breast increased breast cancer risk. The results highlight the need to disseminate information regarding breast density to women, while ensuring that the information is equally accessible to both Black and White women.

Keywords Breast density · Breast cancer · Cancer risk awareness · Cancer screening

Breast density (BD), assessed as the percent of the breast composed of glandular and connective tissue relative to fatty tissue, is directly related to women's breast cancer (BC) risk [1–3]. Analyses show that 5 % of BCs are attributable to BRCA carrier status whereas 16 % of BCs are attributable to BD [2]. Among women with BC, those with more dense breasts have more aggressive tumors [4]. Black women have increased BD compared to White women [5], which may affect Black–White racial disparities in BC mortality [6]. Because they appear the same on an x-ray, highly dense breast tissue may "mask" tumors as they advance undetected to more aggressive stages. Considering that BC is typically diagnosed later among Black women [7, 8], the role of BD in the etiology of the racial disparities warrants investigation. However, little is known about whether women know what "breast density" means or whether they understand the associated BC risks.

A number of studies have presented evidence that, compared to European American women, African American women suffer from a deficit in knowledge related to BC risk. For example, it has been demonstrated that African American women score lower on assessments of BC knowledge, assessments of awareness about BC genetic factors, and accurate perceptions of their own risk [9–11]. We did not identify any studies that included assessments of BD knowledge; hence, we do not know whether similar deficits exist regarding this important risk factor. This gap in the literature amplifies the importance of the current study.

There are numerous sources of information regarding BC risk, yet some sources are inconsistent when it comes to presenting information about BD as a BC risk factor. For example, Susan G. Komen's BC risk web page indicates that BD presents a "strong increase in risk" [12], whereas the Mayo Clinic's corresponding web page does not mention breast density [13]. Furthermore, the unique risk associated with BD does not decrease with age—inasmuch as BD decreases with age, BC risk is associated with *cumulative exposure* to dense breast tissue [14–16]. As biological understanding of BD accumulates, understanding what women know about the BD risk factor is important given that risk awareness can positively influence BC screening rates [17].

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This brief report presents the results of our preliminary investigation of women's BD knowledge and associated BC risk awareness. Using a convenience sample of women who had previously taken part in a BD imaging study with a novel ultrasound tomography device, the study goals were to assess women's (1) BD knowledge, (2) awareness of BC risk associated with BD, and (3) between-race differences in knowledge and awareness.

Method

Participants and Procedure

Participants were women who previously took part in a BD imaging study with novel ultrasound technology (N=333) conducted at a breast clinic within an NCI-designated comprehensive cancer center in Detroit, MI, between 2004 and 2011. We recruited among clinic attendees for whom further screening was prescribed following a suspicious screening or diagnostic mammogram; hence, a larger proportion was expected to have been diagnosed with BC compared to the general population. Eligibility criteria for the original study were: 18+years of age, breast diameter <15 cm, weight <250 lb, not pregnant or breast feeding, and no open breast wounds or skin infections. For the current study, conducted in early 2012, we mailed survey packets containing a participation invitation letter, a separate sheet for a gift card drawing for those who participated, the four-page survey, and a stamped/pre-addressed return envelope. Respondents were given 3 weeks from delivery to return of the surveys. Ninety-seven surveys were undeliverable due to women having moved. Of the 236 surveys that were delivered, 77 women (32.6 %; 23.1 % of the original sample) responded. No information was available for women who did not respond. Twenty six (33.8 %) of the respondents were White, 42 (54.5 %) were Black, and 8 (10.4 %) were from other racial/ethnic groups; one woman did not indicate race/ethnicity and was thus excluded from analyses that tested for between-race differences. The women had a mean age of 51.28 (SD=9.89; range, 25 to 74) and reported that their breast imaging occurred at a mean of 2.59 (SD=2.08)years ago. Twenty-six women (33.8 %) had graduated from college, 50 women (64.9 %) had not; four had not graduated from high school. One woman did not provide education information. A chi-square test among Black and White women indicated no significant association between race and education. Forty-one women (53.2 %) had not been diagnosed with BC, and 30 (42.3 %) were diagnosed; six women did not indicate BC status. Women diagnosed with BC were significantly older (M=54.10 vs. 48.08; $F_{1,\ 65}$=6.47, p<0.05, η^2=0.09). Chi-square analyses among Black and White women showed no association between BC diagnosis and race.

Measures

Breast Density Knowledge We assessed perceived BD knowledge with the item "Do you know what breast density is?" Women responded on a scale from 1 (I have never heard about it) to 5 (I know exactly what it is). To assess knowledge of their own BD, women responded "yes" or "no" to the item "Do you know how dense your own breasts are?" Those who responded "yes" were asked to classify their own BD from 1 (entirely fat) to 4 (extremely dense). We also asked women to define BD in their own words, further instructing them to give it their best guess if they were uncertain. Seventy-two women responded to this item. Three expert judges (MAM, TLA, and LBK) rated the accuracy of the responses on a scale from 1 (not at all correct; e.g., "It's a mammogram. An x-ray. Indicates for breast cancer") to 4 (quite accurate for a lay person; e.g., "Breast density is the amount of breast tissue in relation to fatty tissue in the breast"), with a separate ranking for responses that were irrelevant (e.g., "I'm not sure, but I'm sure I discuss breast density at one time or another"). Inter-rater reliability for rated BD accuracy, indicated by ICC, was good (ICC=0.86, $F_{70,\ 140}$=7.45, p<0.001). Inter-rater reliability remained high when responses that any coder indicated as irrelevant were excluded (ICC=0.86, $F_{61,\ 122}$=7.28, p<0.001).

Risk Factor Awareness We used agreement with statements about known BC risk factors as a measure of risk factor awareness. Women indicated their agreement on a scale from 1 (I strongly disagree) to 5 (I strongly agree) with the following items: age, "Older women are at greater risk for getting breast cancer;" first-degree relative (FDR), "Women with female relatives who have breast cancer are more likely to get breast cancer;" genetic susceptibility, "There is a gene that makes some women more likely to get breast cancer;" BD, "Women with more dense breasts are at greater risk for getting breast cancer."

Results

Breast Density Knowledge

Perceived BD Knowledge Women generally perceived they were aware of BD (M=3.64, SD=1.29). ANOVA indicated significant between-race differences in mean perceived BD knowledge ($F_{2,64}$=5.66, p<0.01), with a planned Black–White contrast indicating significantly greater perceived BD knowledge among White women (M=4.28, SD=0.94) compared to Black women (M=3.29, SD=1.31), t_{64}=3.11, p<0.01, d=0.87. We restricted the sample to Black and White women and conducted a 2 (race) by 2 (education) ANOVA. The race effect remained significant ($F_{1,\ 54}$=6.75,

$p<0.05$, $\eta^2=0.11$), whereas neither the education effect nor the interaction between the two was significant. The results for the race effect were similar when we retained the women in the "other racial/ethnic group" for the analysis ($F_{2,\ 20}=3.95$, $p<0.05$, $\eta^2=0.12$), and the results for education became marginally significant ($F_{1,\ 60}=2.96$, $p<0.10$, $\eta^2=0.05$) with college graduates indicating slightly greater BD knowledge ($M=3.96$, SE=0.30) compared to non-college graduates ($M=3.32$, SE=0.23). A separate ANOVA indicated that BC diagnosis had no effect on perceived BD knowledge.

Rated BD Accuracy Mean rated BD accuracy ($M=2.42$, SD=0.97) indicated that women had neither highly accurate nor highly inaccurate definitions of BD. ANOVA showed marginal omnibus between-race mean differences in BD accuracy ($F_{2,\ 67}=2.86$, $p=0.06$), and planned Black–White contrasts demonstrated that White women had significantly more accurate BD definitions ($M=2.77$, SD=0.93) than Black women ($M=2.27$, SD=0.96) $t_{67}=2.07$, $p<0.05$, $d=0.53$. Importantly, a race-by-education ANOVA among Black and White women yielded no significant race effect or race-by-education interaction. There was only a significant main effect of education ($F_{1,\ 60}=17.23$, $p<0.01$, $\eta^2=0.22$). College graduates' BD definitions were more accurate ($M=3.09$, SE=0.18) than those of non-college graduates ($M=2.16$, SE=0.14). The results were similar when women in the "other racial/ethnic group" were retained for the analysis ($F_{1,\ 63}=9.47$, $p<0.01$, $\eta^2=0.13$).

The correlation between rated BD accuracy and perceived BD knowledge was of medium effect size ($r=0.35$, $p<0.01$) for the whole sample. When examined separately by race, the correlation was large and significant for White women ($r=0.46$, $p<0.05$) but not significant for Black women ($r=0.12$, ns), suggesting that BD knowledge among White women was informed by accurate definitions of BD, but not for Black women. Among women in the "other racial/ethnic group" category, the correlation between BD knowledge and accuracy of BD definitions was large but not significant ($r=0.52$, $p=0.37$). ANOVA showed that BC diagnosis did not impact rated BD accuracy.

Knowledge of Own BD Forty-five women reported that they did not know their own BD; 23 (33.8 %) responded they did. A chi-square test indicated that knowledge of one's own BD was not associated with race (χ^2 (1)=3.60, $p=0.17$). When we restricted the sample to only the Black and White women, results indicated that knowledge of one's own BD was marginally associated with race ($\chi^2(1)=3.39$, $p=0.07$). Black women were less likely to report knowing their own BD (26 observed vs. 22.7 expected), whereas White women were more likely to report knowing their own BD (observed=12, expected=8.7).

Risk Awareness

Women's risk awareness scores were significantly above the scale midpoint for age risk ($M=3.39$, SD=1.43; $t_{73}=2.36$, $p<0.05$), FDR risk ($M=4.03$, SD=1.11; $t_{74}=7.98$, $p<0.01$), and genetic risk ($M=4.13$, SD=1.13; $t_{74}=8.68$, $p<0.01$). Women were marginally aware of the BD risk ($M=3.26$, SD=1.19; $t_{73}=1.85$, $p=0.07$). Perceived BD knowledge was significantly correlated with age risk awareness ($r=0.41$, $p<0.01$). FDR risk awareness was marginally *lower* among women who had been diagnosed with BC ($M=3.73$, SD=1.20) compared to those who had not ($M=4.24$, SD=0.99, $F_{1,\ 69}=3.83$, $p=0.05$, $d_{\Delta\text{mean}}=0.46$). None of the risk awareness variables were correlated with age or rated BD accuracy.

Racial Differences in Risk Awareness Restricting the sample to Black and White women, we conducted a 2 (race) by 2 (education) MANOVA with risk awareness scores as correlated outcomes. There were significant race effects for FDR risk awareness ($F_{1,\ 59}=11.15$, $p<0.01$, $\eta^2=0.16$) and genetic risk awareness ($F_{1,\ 59}=12.71$, $p<0.01$, $\eta^2=0.18$); White women were more aware of FDR risk ($M=4.55$, SE=0.22 vs. $M=3.40$, SE=0.19) and genetic risk ($M=4.67$, SE=0.22 vs. $M=3.65$, SE=0.19). There was a main effect of education on age risk awareness ($F_{1,\ 59}=5.24$, $p<0.05$, $\eta^2=0.08$); college graduates were more aware ($M=3.97$, SE=0.29 vs. $M=3.12$, SE=0.23). There were no significant main effects or interactions of either race or education on BD risk awareness, and no significant race by education interactions on any of the risk awareness constructs. When we included the women in the "other racial/ethnic group" category in the model, the race effects persisted for both FDR ($F_{2,\ 65}=6.02$, $p<0.01$, $\eta^2=0.16$; $M_{\text{other}}=4.23$, SE=0.38) and for genetic risk ($F_{2,\ 65}=6.73$, $p<0.01$, $\eta^2=0.17$; $M_{\text{other}}=4.23$, SE=0.38); however, there was no significant effect of education on age risk awareness.

Predicting Breast Density Risk Awareness For reference, means and bivariate correlations for risk awareness variables are presented in Table 1. We fit a regression predicting BD risk awareness from age, FDR, and genetic risk awareness scores

Table 1 Means, SD, and correlations among risk awareness measures

Risk awareness	*M*	SD	*N*	Age	FDR	Genetic
Age	3.39	1.43	74	–		
FDR	4.03	1.11	75	0.21†	–	
Genetic	4.13	1.13	75	0.28*	0.53*	–
BD	3.26	1.19	74	0.40*	0.20†	0.21†

FDR first-degree relatives, *BD* breast density

*$p<0.05$, †$p<0.10$

to determine whether and which of the awareness scores were *uniquely* related to BD risk awareness. The regression model was significant ($F_{3, 69}$=4.72, p<0.01), accounting for 17 % of the variance in BD risk awareness. The coefficient for age risk awareness was significant (b=0.31, t_{69}=3.21, p<0.01); the coefficients for FDR and genetic risk awareness were not, indicating that women's age and BD risk awareness share variance that is unique from FDR and genetic risk awareness.

Discussion

This is among the first studies to examine women's understanding of BD and its role as a BC risk factor. Women in our sample generally thought they knew what BD was, though White women's perceptions of BD knowledge were generally higher than those reported by Black women. The difference in how accurately women defined BD was due to level of education more so than race. Interestingly, BD knowledge was corroborated by the accuracy of BD definitions only among White women. This may be problematic. For the average White woman, BD information, as reflected by the accuracy of her definition, more likely impacted her perception of her BD knowledge. This relation between accuracy and knowledge perceptions pertaining to BD was absent for the average Black woman. It is possible that Black women are unknowingly getting less accurate information about BD from unreliable sources. Alternatively, Black women may be getting less information in general, or less *interpretable* information specifically, from their doctors. The problematic result is that Black women think they know what BD is, but this perception is not congruent with their actual knowledge. When it comes to the impact of BD knowledge on decision making regarding screening and breast health behaviors, the implications of these discrepancies need further investigation.

Only about a third of the women in the sample knew how dense their own breasts were. This relatively small proportion is unsurprising given that there is no mandated BD reporting in the state of Michigan. Only two states (Connecticut and Texas) mandate BD reporting on mammogram reports. Five states (Kansas, New Hampshire, New York, Ohio, Pennsylvania, and Virginia) have similar legislation pending for 2012 [18]. Women in the initial ultrasound tomography study were not explicitly told the device was being developed to aid in the assessment of BD (though the topic of BD was occasionally discussed). Women also were not given reports of their own BD following study participation. Thus, there is no reason to believe that initial study participation made women generally more knowledgeable about BD.

Women were aware that age, FDR, and genetic susceptibility were risk factors for BC but generally unaware of the BD risk factor. BD knowledge and definitional accuracy did not impact BD risk awareness. Of the risk factors examined, only age-related risk awareness was uniquely associated with BD risk awareness. This is telling in that women are often unaware that age is a risk factor for BC, whereas they tend to be more aware of familial risk factors [19, 20]. Perhaps we could facilitate awareness of the BC risks associated with BD by increasing women's awareness that dense breasts are hereditary [21, 22]. Black and White women were equally *unaware* of BD risk, but White women were more aware of FDR and genetic risks. This between-race difference in risk awareness may help to explain why perceptions of BC risk are lower among Black women compared to White women (e.g., [11]). The absence of between-race differences in BD risk awareness urges diligence in the dissemination of risk knowledge to Black women to safeguard against between-race differences in BD risk knowledge.

There are some limitations in the current study. First, our survey return rate was half of that observed in other BC studies. Recruiting from a nonrandom sample in an impoverished city without offering universal remuneration likely decreased our return rate. Given issues with housing and relocations in Detroit, we assume that some of the undeliverable surveys were not returned. Institutional review board constraints precluded collecting identifying information, so we cannot statistically ascertain differences between women who did and did not reply. The de-identified data also precluded the opportunity to corroborate women's knowledge of how dense their own breasts were with actual imaging data. Finally, women in our sample may not represent the general population as all were previously screened (mammograms and by a novel ultrasound tomography device). Still, these data present an important first step in assessing women's BD knowledge and provide insight into what may predict knowledge related to a robust BC risk factor. Analyses using this special sample of women suggest that it is worthwhile to replicate and extend this work with a more generalizable sample. Future research also ought to examine the extent to which women's knowledge of the density of their own breasts can be corroborated by radiological assessments of their breasts. Finally, given increasing media attention on advising women of how dense their breasts are (e.g., [23]), research ought to examine women's attitudes and potential behavioral intentions associated with receiving breast density information.

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