Colin Mar, MD, Janette Sam, MRT, Colleen E. McGahan, MSc, Kimberly DeVries, MSc, Andrew J. Coldman, PhD

The influence of breast density on breast cancer diagnosis: A study of participants in the BC Cancer Breast Screening Program

A screening participant's risk of being diagnosed with an interval breast cancer following a normal screening mammogram was found to increase with age and density, and to be roughly similar at 1 year for women at higher-than-average risk (first degree family history of breast cancer) to that at 2 years for women at average risk.

ABSTRACT

Background: Normal fibroglandular tissue appears white on a mammogram and is described as dense; fatty tissue appears dark and is described as non-dense. Increased breast density is associated with greater breast cancer risk. Increased breast density also reduces the sensitivity of mammography to reveal changes associated with cancer, a concern referred to as masking. Interval breast cancers are those diagnosed between screening visits and are more common in women with dense breasts. The effects of breast density have been the subject of much research, but the results are often summarized in ways that do not facilitate understanding for referring physicians and screening participants. An analysis of data from the BC Cancer Breast Screening Program was proposed to assess the influence of breast density on the risk of cancer and on breast cancer prognostic factors.

Methods: Although density scores were not required prior to 2018, many BC Cancer Breast Screening Program centres assigned and recorded this information. Two study samples were abstracted from the Breast Screening Program database to achieve four study objectives. Sample 1 data included mammograms of participants age 40 to 74 obtained in 2017 using digital mammography and assigned density categories according to the Breast Imaging-Reporting and Data System (BI-RADS): A (least dense), B, C, or D (most dense). Sample 1 data were used to describe the distribution of BI-RADS breast density in the screening population (Objective 1). A subset of Sample 1 data was used to examine the stability of BI-RADS density categories assigned (Objective 2). Sample 2 data included mammograms performed from 2011 to 2015. Data from this period were used to examine the influence of density on the risk of breast cancer development (Objective 3) and the effect of density on prognostic factors such as tumor size and lymph node involvement (Objective 4). The 2011 to 2015 data collection period was chosen so that notification of any cancer cases to the BC Cancer Registry was complete and 5 years of data could be analyzed. The screening history of each participant in Sample 2 was assessed by screening rounds. Screening rounds that followed an abnormal result were excluded from the analysis as participants were likely subject to further testing prior to returning to screening, and their cases would not necessarily reflect the influence of density on mammography performance. A breast cancer was defined as screen-detected if it was diagnosed in the 12 months following an abnormal screening mammogram. All breast cancers not classified as screen-detected were defined as interval cancers. Rates of screen-detected breast cancer and interval cancer were calculated and rates were estimated for participants at average risk and higher-than-average risk (i.e., having a family history of breast cancer in a first-degree relative).

Dr Mar is medical director of the BC Cancer Breast Screening Program.
Ms Sam is operations director of the BC Cancer Breast Screening Program.
Ms McGahan is director of Cancer Surveillance and Outcomes, BC Cancer.
Ms DeVries is a biostatistician in Cancer Surveillance and Outcomes, BC Cancer.
Dr Coldman is an emeritus scientist in Cancer Control Research, BC Cancer.

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Results: Breast density data analyzed for 208 925 BC Cancer Breast Screening Program participants were seen to vary by age, with a declining proportion of mammograms assigned BI-RADS C and D scores at increasing ages. Density also varied by ethnic group, with East Asian participants having denser breasts and First Nations participants the least dense breasts. Density did not vary by risk status. When 62 887 mammogram pairs from 2017 and earlier were compared, concordance was lowest for mammograms with a BI-RADS score of D. The majority of participants did not have both mammograms read by the same radiologist and concordance was lower when different radiologists read the mammograms than when the same radiologist read both mammograms. Cancer risk was evaluated by looking at 649 393 screening rounds for 388 576 participants. Predicted rates of interval and screen-detected cancer were calculated for women of average risk screened on a biennial (currently recommended) basis and for women of higher-than-average risk screened on an annual (currently recommended) basis. Risk of screen-detected cancer was seen to increase with age and to vary with BI-RADS density for both average-risk and higher-than-average-risk women. Risk of interval cancer also increased with BI-RADS density and with age for average-risk and higher-than-average-risk women. Prognostic factors were tabulated separately for biennial screen-detected cancers and interval cancers. Screen-detected cancers were smaller than interval cancers and less likely to have nodal involvement. Similarly, tumor size increased among interval cancers with increasing density, but the likelihood of nodal involvement did not.

Conclusions: Other studies report similar findings to those described here, with density declining with age, higher density seen in screening participants of East Asian heritage, instability in density categorization on consecutive mammograms, and instability increasing when mammograms are interpreted by different radiologists. When discussing breast screening, breast density alone should not be seen as the primary determinant of breast cancer risk. Following a normal screening mammogram, a screening participant's risk of being diagnosed with an interval breast cancer over the next screening round increases with age and density, and is roughly similar at 1 year for women at elevated risk to that at 2 years for women at non-elevated risk. Further research is needed to elucidate the specific benefits of the increased cancer detection afforded by supplemental testing for screening participants found to have dense breasts.

Background

Breasts are composed of varying amounts of fibroglandular and fatty tissue. Normal fibroglandular breast tissue appears white on a mammogram and is described as dense, while fatty breast tissue appears dark and is described as non-dense. At the population level the average amount of dense tissue declines with increasing age and varies by ethnic group.[1,2]

Increased breast density is associated with greater breast cancer risk. Density also reduces the sensitivity of mammography to demonstrate changes associated with breast cancer.

Radiologists of the BC Cancer Breast Screening Program (BCCBSP) assess breast composition using the Breast Imaging-Reporting and Data System (BI-RADS).[3] A breast density category of A, B, C, or D is assigned based on the amount of fibrous and glandular tissue that appears on a mammogram, with A being least dense (most fatty) and D being most dense (has highest proportion of non-fatty tissue). Quantitative scales that assess the proportion of the breast that is dense[4] are also common, and automated systems producing volumetric density estimates are available.[5] The BCCBSP currently provides BI-RADS breast density scores with all screening mammography results.

Increased breast density is associated with greater breast cancer risk.[6] Density also reduces the sensitivity of mammography to demonstrate changes associated with breast cancer, a concern referred to as masking.[1]

There is considerable interest in the influence of breast density on mammography screening performance. Increased risk and masking act synergistically to increase rates of interval breast cancer that occur between screening visits after a normal screening mammogram.[7] The primary objective of breast screening is to reduce the risk of breast cancer death in participants by diagnosing cancers when treatment outcomes are considerably better than would pertain if they were diagnosed later.

Screening participants diagnosed with interval cancers have not benefited from screening since their time of diagnosis and stage of disease at diagnosis are unchanged by participation in screening. In many United States jurisdictions, legislation mandates the reporting of breast density to the referring health care provider and screening participant,[8] and supplemental testing is offered to those with denser breasts (identified as BI-RADS C or D). Currently in British Columbia, breast density is reported to screening participants and their physicians. In Canada, the organization Dense Breasts Canada advocates for increased knowledge and awareness of the effects of breast density.[9]

Although the effects of breast density have been the subject of much research, the results are often summarized in ways that do not facilitate understanding for referring physicians and screening participants. Consequently, we proposed an analysis of BCCBSP data on density and subsequent breast cancer diagnoses with four objectives:

1. To describe the distribution of BI-RADS density categories within the population presenting to BCCBSP for routine breast screening.
2. To assess the stability of BI-RADS density categories assigned to screening participants.
3. To examine the influence of density on the risk of breast cancer in screening participants.
4. To examine the effect of density on breast cancer prognostic factors.

Methods

The BC Cancer Breast Screening Program maintains records of all examinations performed. Although density scores were not required prior to 2018, many screening centres assigned BI-RADS density scores and this

information was recorded in the BCCBSP database. This database contains details on the mammogram performed, including the result, and information on the participant (age, self-reported ethnic group, etc.). The British Columbia Cancer Registry (BCCR) records all cancers diagnosed in British Columbia residents, and it is routinely linked with the Breast Screening Program database so that all breast cancers occurring in screening participants are identified.

Two study samples were used to achieve the four study objectives.

Sample 1 data included mammograms of participants age 40 to 74 obtained in 2017 using digital mammography and reporting BI-RADS density **[Figure 1]**. Sample 1 data were used to describe the distribution of BI-RADS breast density categories in the screening population (Objective 1). A subset of Sample 1 data **[Figure 1]** was used to examine the stability of BI-RADS density categories assigned (Objective 2). The interval of 18 to 30 months between screening rounds was selected to encompass the usual range of rescreening times in participants recommended for biennial screening.

Sample 2 data included mammograms performed from 2011 to 2015 **[Figure 2]**. Sample 2 data were used to examine the influence of density on the risk of breast cancer (Objective 3) and the effect of density on prognostic factors such as tumor size, whether less than or more than 15 mm, and lymph node involvement (Objective 4). The 2011 to 2015 data collection period was chosen so that notification of any cancer cases to the BCCR was complete and 5 years of data could be analyzed.

The screening history of each participant in Sample 2 was assessed by screening rounds. A screening round started immediately after a mammographic examination and ended with the next screening visit, a diagnosis of cancer, or the end of the data collection period (31 December 2015). Each screening round had factors associated with it taken from the preceding screening visit. Screening rounds that followed an abnormal result were excluded from the analysis as participants were likely subject to further testing prior to returning to screening and their cases would not necessarily reflect the influence of density on mammography performance. Consequently, all screening rounds commenced following a normal screening mammogram in the study period.

A breast cancer was defined as screen-detected if it was diagnosed in the 12 months following an abnormal screening mammogram. All breast cancers not classified as screen-detected that occurred within specified rescreening intervals (annual, biennial, or triennial) were designated as interval cancers.

Rates of screen-detected breast cancer and interval cancer were calculated and analyzed. Rates were estimated for screen-detected and interval cancer for participants at average risk and higher-than-average risk.

The study was approved by the British Columbia Cancer Agency Research Ethics Board approval number H19-02530.

Results

Breast density data were analyzed for 208 925 BC Cancer Breast Screening Program participants age 40 to 74 who had a digital mammogram in 2017 **[Figure 3]**. Density was seen to vary by age, with an increasing proportion

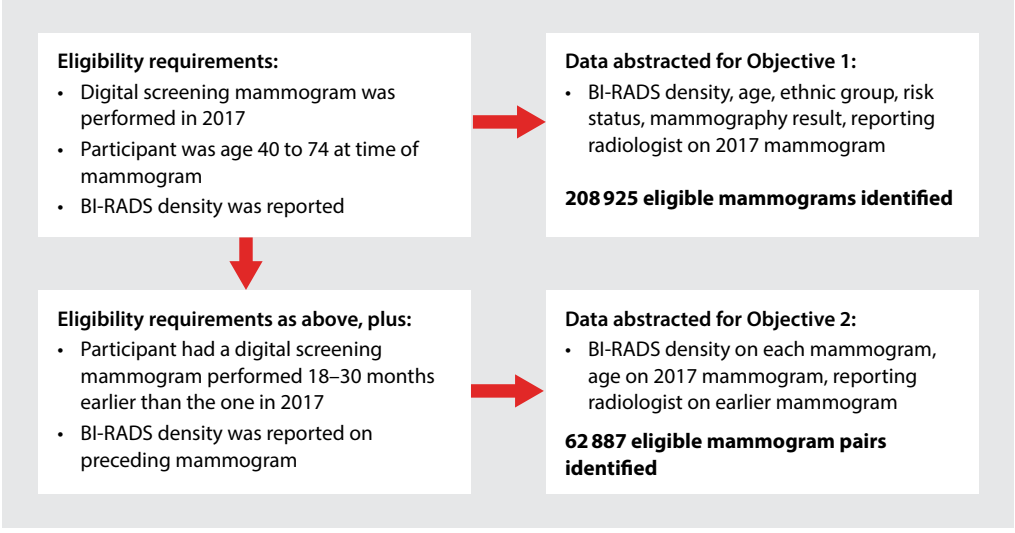

FIGURE 1. Sample 1 data used to examine BI-RADS breast density categories (Objective 1) and the stability of BI-RADS categories (Objective 2) in BC Cancer Breast Screening Program population.

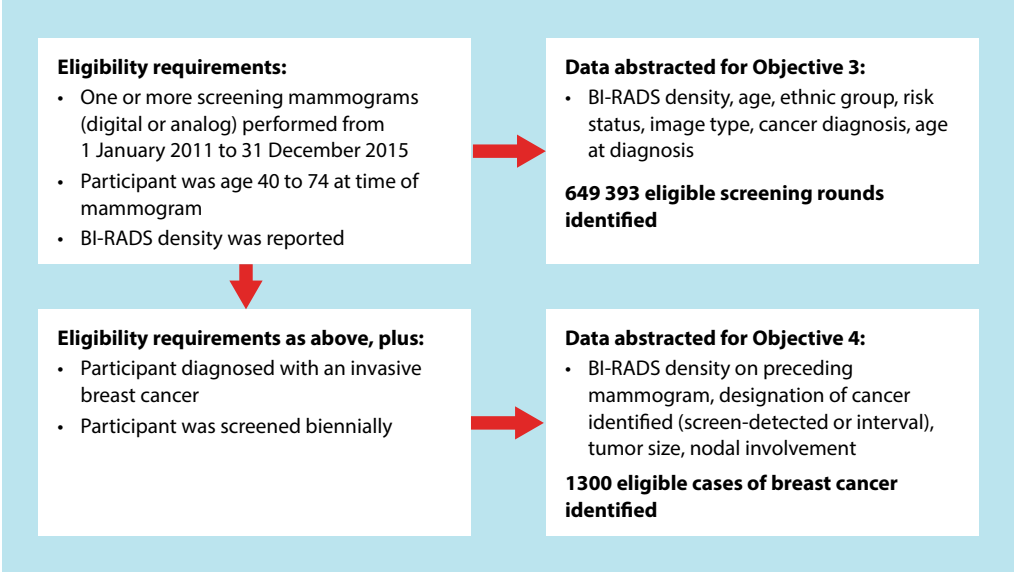

FIGURE 2. Sample 2 data used to examine the influence of density on the risk of breast cancer (Objective 3) and breast cancer prognostic factors (Objective 4) in BC Cancer Breast Screening Program population.

of BI-RADS A and B mammograms and a declining proportion of BI-RADS C and D mammograms at increasing ages. Density also varied by ethnic group, with East Asian participants having the densest breasts and First Nations participants the least dense. Density did not vary by risk status. Mammograms interpreted as abnormal were less likely in BI-RADS category A (5.3%) than category B (9.4%), category C (10.5%), and category D (10.7%).

When 62 887 mammogram pairs from 2017 and earlier were compared, concordance was lowest for mammograms designated BI-RADS category D, with only 50.9% of mammograms designated as D on the first mammogram being designated D subsequently [**Table 1**]. Concordance overall was 68.7% (same BI-RADS density on both mammograms) and 82.5% for categories C and D combined. The majority of participants (73.5%) did not have both mammograms read by the same radiologist and concordance was lower when different radiologists read the mammograms (65.5%) than

TABLE 1. BI-RADS breast density categories reported on 2017 mammograms compared with categories reported on earlier mammograms.

Category	Number	Result on earlier mammogram		Result on 2017 mammogram		
		BI-RADS D	BI-RADS C or D	Same on both (%)	BI-RADS D on both (% of D on earlier)	BI-RADS C or D on both (% of C or D on earlier)
Age 40–49	8742	1520	5564	5872 (67.2%)	894 (58.8%)	4858 (87.3%)
Age 50–59	21 453	2119	10 587	14 729 (68.7%)	1034 (48.8%)	8708 (82.3%)
Age 60–69	23 318	1254	8109	16 168 (69.3%)	585 (46.7%)	6531 (80.5%)
Age 70–74	8165	340	2269	5623 (68.9%)	148 (43.5%)	1795 (79.1%)
Same reporting radiologist	16 690	1241	7234	12 913 (77.4%)	769 (62.0%)	6285 (86.9%)
Different reporting radiologist	46 197	4031	19 599	30 297 (65.5%)	1913 (47.5%)	15 840 (80.8%)
All	62 887	5272	26 833	43 210 (68.7%)	2682 (50.9%)	22 125 (82.5%)

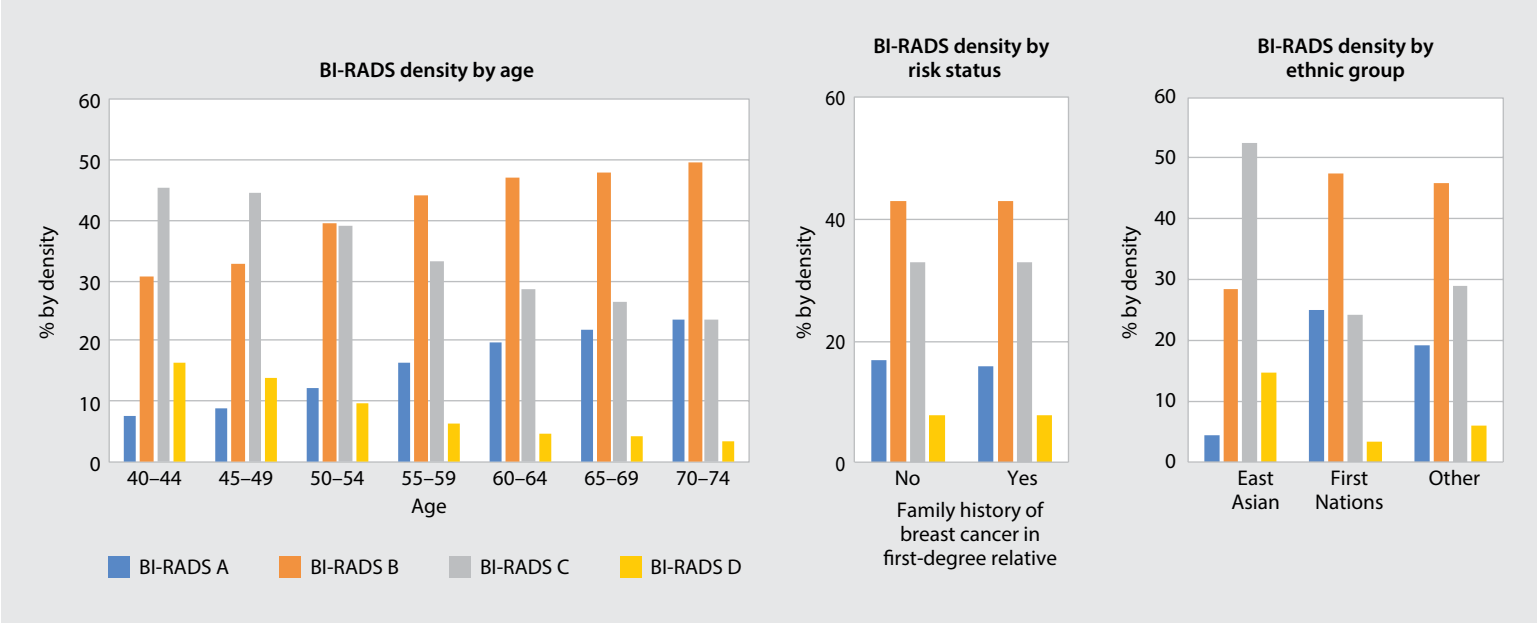

FIGURE 3. Breast density of participants screened in 2017 by age, risk status, and ethnic group.

TABLE 2. Screening round factors considered, including participant risk status, age, ethnic group, BI-RADS density category, and mode of detection for invasive breast cancers identified.

Factor		Number	%
First screening visit prior to round	No	582 337	89.7
	Yes	67 056	10.3
Higher-than- average risk	No	531 587	81.9
	Yes	117 806	18.1
Age at beginning of screening round	40–44	70 532	10.9
	45–49	106 729	16.4
	50–54	109 482	16.9
	55–59	112 096	17.3
	60–64	105 262	16.2
	65–69	87 763	13.5
	70–74	57 529	8.9
Image type of preceding mammogram	Analog	275 044	42.3
	Digital	374 349	57.7
Ethnic group	East/Southeast Asian	90 077	13.9
	First Nations	13 349	2.1
	Other	535 949	82.5
BI-RADS density at preceding mammogram	A	170 958	26.3
	B	243 738	37.5
	C	183 487	28.3
	D	51 210	7.9
Mode of detection for invasive breast cancer identified	Screen-detected	1513	58.9
	Not screen-detected	1057	41.1

when the same radiologist read both mammograms (77.4%).

Cancer risk was evaluated by looking at 649 393 screening rounds for 388 576 participants **[Table 2]**. The use of screening rounds resulted in the data being weighted by participants who attended screening more frequently. Within the study period, 3117 breast cancers were identified, of which 547 were ductal carcinoma in situ (DCIS). Most BC-CBSP screening centres (37 of 41 or 90%) recorded BI-RADS density for some screening rounds. Predicted rates of interval and screen-detected cancer were calculated for average-risk women screened on a biennial (currently recommended) basis **[Figure 4]** and for higher-than-average-risk women screened on an annual (currently recommended) basis **[Figure 5]**. Risk of screen-detected cancer was seen to increase with age and to vary with BI-RADS density for both average-risk women and higher-than-average-risk women. Risk of interval cancer also increased with BI-RADS density and with age for average-risk and higher-than-average-risk women. For women with BI-RADS category D density, however, a change from biennial screening to annual screening was found to have only a modest effect on the predicted proportion of interval cancer found at the next screening visit: a change from 58% (biennial) to 54%

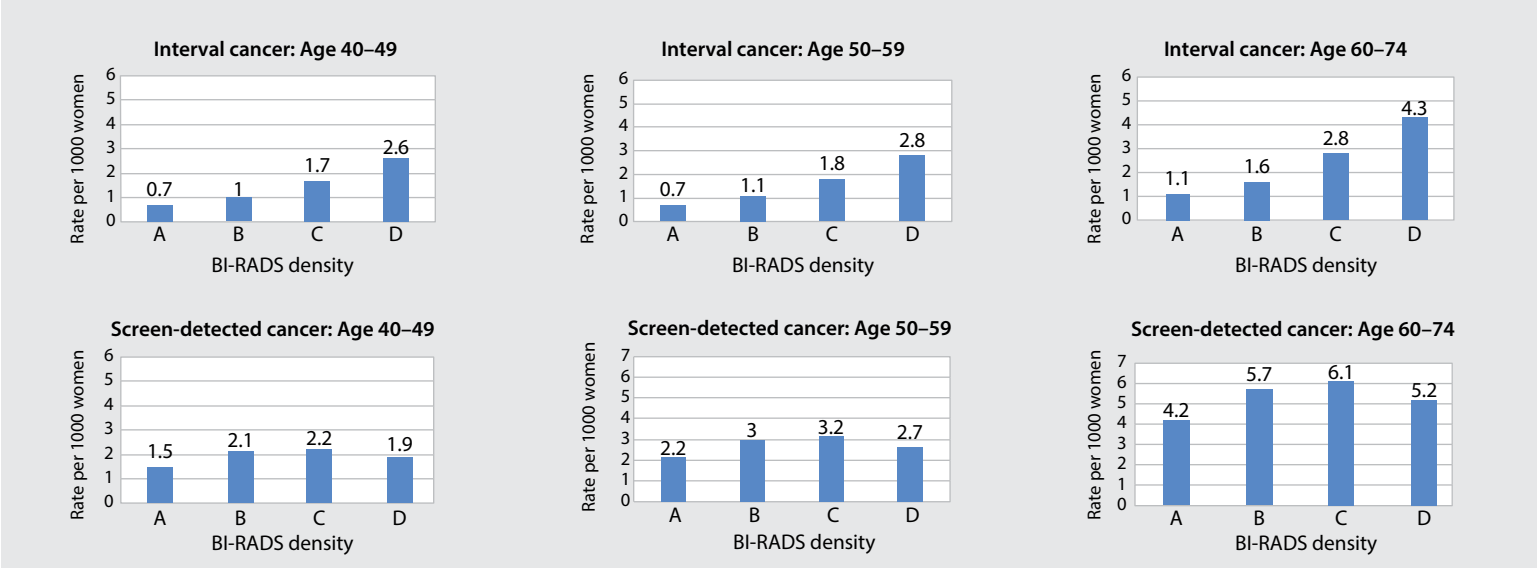

FIGURE 4. Predicted rate by age and density for average-risk women to be diagnosed with interval cancer in the next 2 years or screen-detected cancer at the next biennial screening visit following a normal mammogram.

(annual) for women age 40 to 49, from 51% (biennial) to 46% (annual) for women age 50 to 59, and from 45% (biennial) to 40% (annual) for women age 60 to 74.

Prognostic factors were tabulated separately for biennial screen-detected cancers and interval cancers **[Table 3]**. Tumors in screen-detected cancers were smaller than in interval cancers ($P < 10^{-5}$) and less likely to have nodal involvement ($P < 10^{-5}$). Within the screen-detected cancers, tumor size increased with increasing density (test for trend, $P = .005$), but the likelihood of nodal involvement did not increase ($P = 0.06$). Similarly, among interval cancers, tumor size increased with increasing density ($P = .0002$), but the likelihood of nodal involvement did not ($P = .19$).

Conclusions

The analysis of digital screening mammograms performed by the BC Cancer Breast Screening Program in 2017 showed that breast density decreased with age, was lower in First Nations and higher in East Asian participants, and did not vary by risk status. Examination of consecutive digital mammograms found that recorded density was not stable and that concordance (the same BI-RADS density reported on both mammograms) was less likely when different radiologists interpreted the two mammograms. Rates of screen-detected and interval invasive breast cancers were found to vary with age and risk status. Rates of screen-detected cancer varied with density, although rates did not increase uniformly with increased density. In contrast, rates of interval cancer increased progressively with increasing density. Tumor size at diagnosis increased with increasing density, but the likelihood of nodal involvement did not change.

Other studies

Other studies report similar findings to those demonstrated here, with density declining with age[10] and higher density seen in East Asians.[11] Similarly, other studies report instability in density categorization on consecutive mammograms[12] and instability increasing when

TABLE 3. Prognostic factors (tumor size and nodal involvement) for screen-detected, at 18–30 months, and interval, within 24 months, invasive breast cancers compared by BI-RADS density category.

	Mode of detection						Overall rates*	
	Screen-detected cancer diagnosed 18–30 months			Interval cancer diagnosed < 24 months				
Density	Number	% > 15 mm (95% CI)	% + node (95% CI)	Number	% > 15 mm (95% CI)	% + node (95% CI)	% > 15 mm (95% CI)	% + node (95% CI)
A	207	25.6 (20–32)	11.6 (8–17)	102	50.0 (40–60)	20.6 (14–29)	32	14
B	317	28.4 (24–34)	18.0 (14–23)	190	58.4 (51–65)	32.6 (26–40)	36	22
C	190	38.4 (32–46)	19.5 (14–26)	201	65.7 (59–72)	33.3 (27–40)	49	25
D	26	38.5 (22–57)	15.4 (6–34)	67	76.1 (65–85)	28.4 (19–40)	58	22
All	740	30.5 (27–34)	16.5 (14–19)	560	61.6 (58–66)	30.2 (27–34)		

*Obtained by weighting screen-detected and interval cancer rates per 1000 as shown in Figure 4.

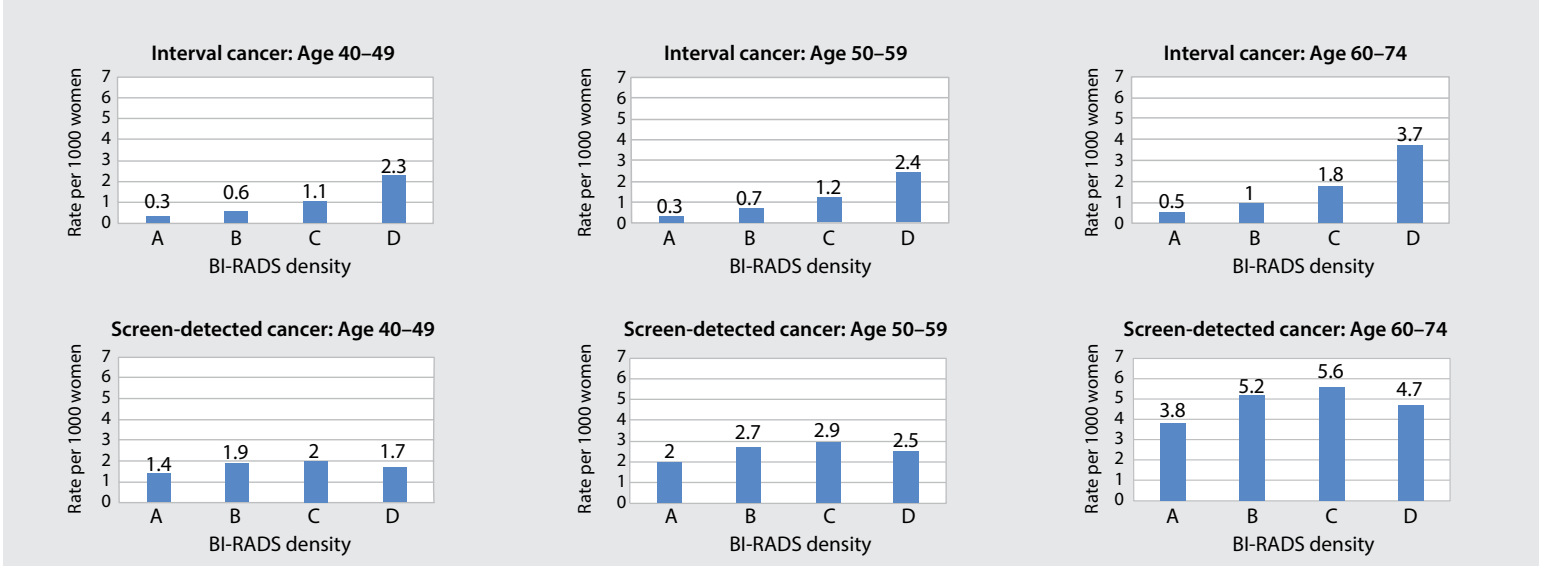

FIGURE 5. Predicted rate by age and density for higher-than-average-risk women to be diagnosed with interval cancer in the next year or screen-detected cancer at the next annual screening visit following a negative mammogram.

mammograms are interpreted by different radiologists.[13-15] An increase in the rates of screen-detected and interval cancer with the length of the screening interval (annual, biennial, and triennial) is commonly observed.[16] Other studies have also found that rates of screen-detected[7] and interval[17] cancer vary with reported density. In reporting relationships with screen-detected cancers, studies[7] have used density recorded on the mammogram leading to screen detection rather than the preceding mammogram as done in this study. The reason for using the preceding mammogram here is so that reported rates of both screen-detected and interval cancers relate to the likelihood of future events in participants who have had a normal screening mammogram.

Risk

Many factors other than age, family history, and breast density have been found to influence breast cancer risk. These include ethnicity, age at menarche, menopause status, history of pregnancy, body mass index, activity level, alcohol consumption, tobacco consumption, and history of benign breast disease.[18] Individual risk is not indicated by a single factor alone and tools have been developed to provide estimates using some of these factors.[19,20] Using single factors to predict risk is further complicated by negative correlations between some risk factors (e.g., breast density and body mass index).When discussing breast screening, breast density alone should not be seen as the primary determinant of breast cancer risk.

Study challenges

Although breast density reporting was not required by the screening program during the study, the majority of BC screening centres did report density voluntarily and provided these data to the program. BI-RADS density was not reported to physicians or patients undergoing screening and was not used for routine clinical care, meaning that the results may not be representative of density when reported for use in clinical care.

For the evaluation of density category stability, only digital mammography results were used. This was not the case for evaluation of breast cancer risk, where 42% of the studies were performed using analog mammography. Digital mammography has been found to show higher sensitivity in the presence of density,[21] suggesting that the relationships with interval cancers reported here could change if all screening for this study had been conducted using digital mammography. The breast cancer risk portion of this study used data from 2011 to 2015. During this period the BI-RADS density assessment system was updated to its fifth edition,[3] a change that is reported to have resulted in differential classification of mammographic density.[22]

Breast density decreased with age, was lower in First Nations and higher in East Asian participants, and did not vary by risk status.

Prior to February 2014, British Columbia screening policy recommended annual screening for women age 40 to 49 and biennial screening for women age 50 to 79. After 2014, biennial screening was recommended for average-risk women age 50 to 74 and 40 to 49 (if electing screening), and annual screening for women with a family history of breast cancer in a first-degree relative. Consequently, many of the rates presented in **Figure 4** and **Figure 5** represent screening practice not recommended for part of the data collection period, and observed rates may have been influenced by factors not captured in the analysis.

Sensitivity is commonly used to measure the accuracy of diagnostic tests. However, as usually defined, this sensitivity measure cannot be assessed in screening participants because of the absence of an accepted gold standard for identifying breast cancer in asymptomatic women. Consequently, alternate measures are used. The most common of these is period sensitivity,[23] which is equal to the ratio of screen-detected to screen-detected-plus-interval cancer rates over the screening period. Several studies have reported period sensitivity with density and have found that it declines with increasing density.[24] Period sensitivity was not calculated using the results presented in **Figure 4** and **Figure 5** because the rate of screen-detected cancer is from the following screen and not the current screen. Nevertheless, the ratio of screen-detected to screen-detected-plus-interval cancer declines with increasing density as has been seen elsewhere. It must also be kept in mind that the rates presented in **Figure 4** and **Figure 5** do not include in situ breast cancers or breast cancers detected at a first screening visit; inclusion of such cases would increase the ratio of screen-detected to screen-detected-plus-interval cancers.

Study implications

The relationship between higher density and future interval cancer risk is of concern because it suggests that screening participants with the densest breasts may benefit less from screening. On an absolute scale, those with the lowest density likely benefit the least from screening since they have the lowest rate of breast cancer detected at screening. However, those with the highest density have elevated interval cancer rates before the next screening visit and may thus represent the greatest opportunity for potential cancer detection improvement. Importantly, though, all age, risk, and density subgroups are diagnosed with screen-detected and interval cancers. There is no national standard defining what risk threshold, if any, is sufficient to consider altering screening recommendations. Indeed, mammography remains the primary screening tool regardless of breast density. Current Canadian breast screening recommendations do not indicate further breast screening in addition to routine mammography.[25] In the United States, where most screening is performed annually, it has been suggested[17] that an annual interval cancer risk threshold of 1 per 1000, which is exceeded for women with BI-RADS D, is an appropriate threshold to consider additional screening interventions. However, the US Preventive Services Task Force considers evidence to be insufficient to recommend any adjunctive screening on the basis of breast density alone.[26]

In Europe and Australia, breast screening policy does not vary with breast density. In Canada, several provinces increase the mammography frequency from biennial to annual for average-risk participants with the densest

breasts (generally those categorized BI-RADS D). However, our results for women with BI-RADS category D density show that a change from biennial to annual screening has only a modest effect on the predicted proportion of interval cancers. In the US, despite the absence of supporting guidelines, it is common to offer breast ultrasound and possibly breast magnetic resonance imaging to women with BI-RADS C or D breast density following a normal screening mammogram. Many studies have shown that the addition of breast ultrasound results in the identification of mammographically occult breast cancer and a recent systematic review[27] concluded that it increases the screen-detection rate by an average of 40% of that detected at mammography. A randomized clinical trial in Japanese women aged 40 to 49 is currently comparing adding ultrasound to mammography and clinical breast examination.[28] The first round of this study found a 55% increase in screen-detected cancer with a similar proportional increase across breast densities,[29] and a 37% reduction in interval invasive breast cancer in those receiving ultrasound screening. While it is unlikely that screening can produce further reductions in breast cancer mortality among existing participants without substantially reducing interval cancer rates, reductions in interval cancers alone do not guarantee a reduced risk of death. Reductions would also be required in the overall frequency of advanced cancers (screen-detected-plus-interval).

The previous discussion concerns the detection of invasive breast cancer, but overall approximately 22% of cancers detected on screening mammography are DCIS, which in BC is seen to decline with age. In 2017 DCIS represented 33% of cancer diagnoses in participants aged 40 to 49 and only 15% of those 70 to 79.[30] The proportion of DCIS detected by breast ultrasound following a normal mammogram is lower than that for mammography. For example, in the J-START trial, 37% of cancers detected by mammography were DCIS versus 16% of cancers detected by breast ultrasound in those with a normal screening mammogram.[28] Given an estimated conversion rate of DCIS to invasive disease of less than 1% per year[31] a lower proportion of cancers detected by breast ultrasound than by mammography may not be disadvantageous. Reported false-positive rates for breast ultrasound are variable[27] and can be comparable to those associated with screening mammography. In the J-START trial, where participating centres received specific training on the performance and interpretation of screening ultrasounds, 6.6% of participants had an abnormal screening mammogram result. Among those with a normal screening mammogram, 5.7% had an abnormal screening ultrasound result. The positive predictive value for breast cancer detection was 4.8% for the screening mammogram and 3.6% for the screening ultrasound.[28]

Rates of interval cancer increased progressively with increasing density. Tumor size at diagnosis increased with increasing density, but the likelihood of nodal involvement did not change.

Summary

Based on findings reported in the literature and the data presented here, physicians with patients enrolled in the BC Cancer Breast Screening Program can expect the following:

- Younger patients are more likely to have denser breasts since breast density tends to decrease with age.
- Women of East Asian heritage are more likely than other screening participants to have denser breasts, although their risk of breast cancer is lower on average.
- Screening participants with a first degree family history of breast cancer are not more likely to have dense breasts.
- The breast density categorization of many screening participants will change on consecutive mammograms.
- Other factors (e.g., body mass index) will influence both breast density and breast cancer risk.

Following a normal screening mammogram, a screening participant's risk of being diagnosed with an interval breast cancer over the next screening round increases with age and breast density, and is roughly similar at 1 year for women at elevated risk to that at 2 years for women at non-elevated risk.

These findings are intended to facilitate a discussion of breast density, breast cancer risk, the role of mammography in screening, and the role of supplemental testing. Breast density is one of multiple breast cancer risk factors to be considered, and its greatest impact is on the risk of interval cancer. While women age 40 to 74 with the densest breasts (BI-RADS D) but of otherwise average risk may benefit the most from additional testing, annual mammography was not found to offer a significant improvement.

The benefits and limitations of supplemental ultrasound should always be considered. Evidence indicates that ultrasound does detect additional cancers but is accompanied by the additional probability of false-positive studies and the need for biopsy.

Further research is needed to elucidate the specific benefits of the increased cancer detection afforded by supplemental testing for screening participants found to have dense breasts. ■

Competing interests

All authors are affiliated with the BC Cancer Breast Screening Program. Dr Coldman serves as a consultant for the BC Cancer Breast Screening Program and was paid for drafting this report.

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