Breast Density Distribution of Thai Women in Thammasat University Hospital; Comparison between The 4th and The 5th Edition of ACR BI-RADS

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Background: *Recently, American College of Radiology issued the latest 5th edition of BI-RADS Atlas which changed nomenclature and method to categorized breast composition.*
Objective: *To compare breast composition distribution between the 4th and the 5th edition of BI-RADS and to evaluate reader variability of breast composition according to the 5th edition.*
Material and Method: *Comparison of breast composition distribution between the 4th and the 5th edition of BI-RADS; interobserver and intraobserver agreement of breast composition of the 5th edition of BI-RADS between groups of readers were analyzed using 300 cases with mammography from January 2013 to December 2013.*
Results: *The breast composition distribution between the 4th and the 5th edition of BI-RADS had high correlation. The 5th edition BI-RADS had moderate to substantial interobserver agreement and substantial to almost perfect intraobserver agreement.*
Conclusion: *The breast composition distribution had no significant difference between the 4th edition and the 5th edition of BI-RADS. The 5th edition of BI-RADS also had good interobserver agreement among radiologists.*

Keywords: *BI-RADS, Breast density, Interobserver, Intraobserver*

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Breast cancer is the most common invasive cancer and cause of death of women worldwide[1-3]. The main tool for early breast cancer detection is screening mammography. Breast composition in mammography is one of the risk factor for developing breast cancer[4]. The denser breast has higher incidence of breast cancer but decreased sensitivity of screening mammography. Therefore breast composition assessment is an important component of the mammography report.

The American College of Radiology (ACR) developed Breast Imaging Reporting and Data System (BI-RADS) to standardize interpretation and reporting of mammography, ultrasound and magnetic resonance imaging (MRI) findings. In 2014, ACR has updated and published the latest 5th edition of BI-RADS Atlas (5) that changed the assessment methods of breast composition, including using A, B, C, D instead of 1, 2, 3, 4. "A" is entirely fatty and "D" is extremely dense (Table 1). And using the densest part of the breast density for "breasts containing coalescent areas of fibroglandular tissue that are sufficiently dense to obscure small mass" rather than using quantitative area-based percentage ranges.

The previous edition used amount of fibroglandular tissue compared with total area of the breast to assess the breast composition and there were several studies that found good or substantial agreement in both intraobserver and interobserver agreement[6,7]. But there were few studies about this agreement in the new breast composition[8]. We concerned that the change of the new edition might affect the reporting results and confidence of radiologists. The objectives of this study were to compare breast composition distribution between the 4th and the 5th edition of BI-RADS and to evaluate reader variability of breast composition of the 5thedition of BI-RADS.

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Material and Method

The authors randomly selected 314 cases who underwent mammography from January to December 2013 in Thammasat University Hospital. We excluded

Table 1. Breast composition category of the 4th and the 5th edition of BI-RADS

The 4th edition	The 5th edition
1) The breast is almost entirely fat (<25% glandular)	A) The breasts are almost entirely fatty
2) There are scattered areas of fibrojglandular densities (25 to 50% glandular)	B) There are scattered areas of fibroglandular density
3) The breast tissue is heterogeneously dense, which could obscure detection of small masses (51 to 75% glandular)	C) The breasts are heterogeneously dense, which may obscure small masses
4) The breast tissue is extremely dense. This may lower the sensitivity of mammography (>75% glandular)	D) The breasts are extremely dense, which lower the sensitivity of mammography

14 patients, including 4 patients who were categorized in BI-RADS 4 and 5 but lack of pathological results, 7 patients who were categorized in BI-RADS 3 but loss follow-up in 2 years, and 3 patients who had previous breast surgery. Mammographic images, ACR BI-RADS categories, age and pathological results (in BIRADS 4 and 5) of 300 women were collected.

Mammograms were performed by using a Lorad/Hologic Selenia full-field digital mammography system.

Breast composition was qualitatively evaluated by radiology resident (reader 1) and two experienced radiologists (reader 2 and reader 3), using the 4th and the 5th editions of BI-RADS. Breast density was categorized as "A to D" for the 5th edition of BI-RADS and "1 to 4" for the 4th edition of BI-RADS. The authors chose the highest density view if images had different attenuation between two views.

The readers interpreted breast composition on two mammographic standard views (craniocaudal and mediolateral views) independently and randomly. The reader one was the third year resident in diagnostic radiology training. The reader 2 has experience in breast imaging for 6 years and underwent training in breast imaging. The reader 3 has experience in general and breast imaging for 8 years.

Breast composition assessment of the 4th edition of BI-RADS and two times breast composition evaluation of the 5th edition were done by reader 1 and reader 2. Time interval between the 1st interpretation and the 2nd interpretation was about 3 months.

Comparison of the 5th edition of BI-RADS for interobserver agreement were done between reader 1 and reader 2, reader 1 and reader 3, and reader 2 and reader 3.

Statistical analysis

Spearman correlation with its 95% confidence interval (95% CI) was used to calculate breast composition correlation between the 4th and the 5th edition of BI-RADS, *p*-value <0.05.

Weighted kappa coefficient (K) and 95% CI was calculated to evaluate interobserver agreement of the 5th edition of BI-RADS. Kendall rank correlation coefficient test and 95% CI was used to evaluate intraobserver agreement of breast composition of the 5th edition of BI-RADS.

Chi-square test and 95% CI was used to calculate correlation of breast composition of the 5th edition and occurrence of breast cancer.

Results

The patient age of these 300 women ranged between 30 to 80 years. Twenty three cases were between 30 to 39 years (7.67%), 104 cases were between 40 to 49 years (34.67%), 115 cases were between 50 to 59 years (38.33%), 46 cases were between 60 to 69 years (15.33%) and 13 cases were more than 70 years (4.33%). The mean age was 51.8. Thirteen cases (4.33%) were proved to be breast cancer.

The breast composition of most women was dense breast according to both editions. Most of the breast density, using the 5th edition of BI-RADS, had one-level higher category than using the 4th edition of BI-RADS (Table 2).

Correlation of breast density distribution between the 4th and the 5th edition of BI-RADS by radiology resident (reader 1) and radiologist (reader 2) by using Spearman Correlation score were 0.758 and 0.808, respectively. The results were of substantial relationship (Table 3).

The interobserver reliability analysis of breast composition of the 5th edition of BI-RADS between reader 1 and reader 2, reader 1 and reader 3 was of moderate agreement (Table 4). The Kappa scores were 0.453 [*p*-value <0.001, 95% CI (0.410, 0.496)] and 0.476

Table 2. Breast composition distribution by reader 2

The 4th edition category (n = cases)	The 5th edition category [n = cases (%)]
1 (n = 9)	A, [n = 7 (77.78)]
	B, [n = 2 (22.22)]
2 (n = 41)	B, [n = 21 (51.22)]
	C, [n = 19 (46.34)]
	D, [n = 1 (2.44)]
3 (n = 138)	B, [n = 1 (0.72)]
	C, [n = 81 (58.70)]
	D, [n = 56 (40.58)]
4 (n = 112)	C, [n = 3 (2.68)]
	D, [n = 109 (97.32)]

Table 3. Correlation of breast density distribution between the 4th and the 5th edition of BI-RADS.

	Correlation score
Reader 1	0.758
Reader 2	0.808

Correlation score 0.81-1.00 = Almost perfect; 0.61-0.80 = Substantial, 0.41-0.60 = Moderate; 0.21-0.40 = Fair, 0.00-0.20 = Slight and <0.00 = Poor (Landis and Koch (1977)

[*p*-value <0.001, 95% CI (0.437, 0.518)], respectively. But the interobserver reliability analysis between reader 2 and reader 3 was of substantial agreement, the kappa score was 0.728 [*p*-value <0.001, 95% CI (0.692, 0.764)]. Intraobserver agreement of breast composition of the 5th edition of BI-RADS showed almost perfect agreement of reader 1 and substantial agreement of reader 2 (Table 5). Kendall's tau-b score of reader 1 was 0.831 [*p*-value <0.001, 95% CI (0.669, 0.739)] and Kendall's tau-b score of reader 2 was 0.703 [*p*-value <0.001, 95% CI (0.533, 0.615)].

When categolized with the 5th edition of BI-RADS, malignancy was not found in breast density category A (0/7). There were 2 cases of breast cancer in category B (2/24, about 8.33%), 8 cases in category C (8/103, about 7.77%) and 3 cases in category D (3/166, about 1.81%). The calculated Chi-square was of no statistical significance, *p*-value was 0.689.

Discussion

The result of this study showed good correlation of breast composition distribution assessment between the 4th and the 5th edition of BI-RADS evaluated by radiology resident (reader 1) and radiologist (reader 2). So the breast density distribution of the new edition is not much changed. The breast composition was dense breast (heterogeneously dense fibroglandular tissue and extremely dense fibroglandular tissue) in most of patients of both editions of BI-RADS. However, there was tendency to increased level category of breast composition according to the 5th edition compared to the 4th edition. For example, the fibroglandular tissue volume of the 4th edition of BI-RADS might account for less than 50% and was in category 2 but it had the area of high concentration of fibroglandular tissue and was considered to obscure some nodules, therefore this breast composition was interpreted as category C or D according to the 5th edition of BI-RADS (Fig. 1). The woman who had uniform distribution of fibroglandular tissue in whole breast should be classified as the same breast density category of both editions of BI-RADS (Fig. 2).

Table 4. Interobserver agreement of breast composition of the 5th edition BI-RADS by three readers

Reader	Kappa score
Reader 1 and reader 2	0.453
Reader 1 and reader 3	0.476
Reader 2 and reader 3	0.728

K score 0.81-1.00 = Almost perfect; 0.61-0.80 = Substantial; 0.41-0.60 = Moderate; 0.21-0.40 = Fair; 0.00-0.20 = Slight and <0.00 = Poor agreement (Landis and Koch (1977)

Table 5. Intraobserver agreement of breast composition of the 5th edition BI-RADS by reader 1 and reader 2

	Kendall's tau-b score
Reader 1	0.831
Reader 2	0.703

Kendall's tau-b score 0.81-1.00 = Almost perfect; 0.61-0.80 = Substantial; 0.41-0.60 = Moderate; 0.21-0.40 = Fair; 0.00-0.20 = Slight and <0.00 = Poor (Landis and Koch (1977)

The interobserver agreement of breast composition of the 4th edition of BI-RADS was rather high, corresponding with the previous study of Winkel RR et al[6] that found moderate to substantial agreement. However, the interobserver agreement of the 5th edition of BI-RADS between radiology resident (reader 1) and each radiologist (reader 2 and 3) showed moderate

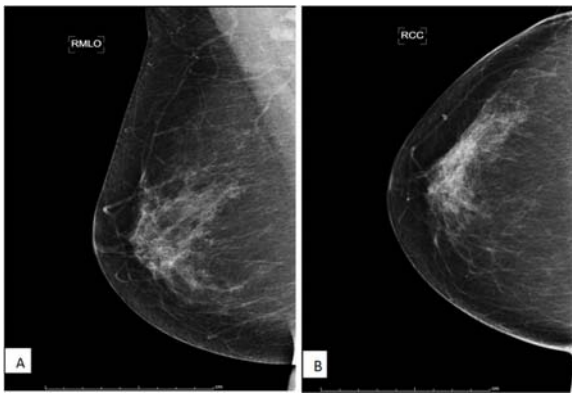

Fig. 1 Mammogram in MLO (A) and CC (B) views: The breast composition was categorized in group 2 by using the 4th edition of BI-RADS but was categorized in group C by using the 5th edition of BI-RADS.

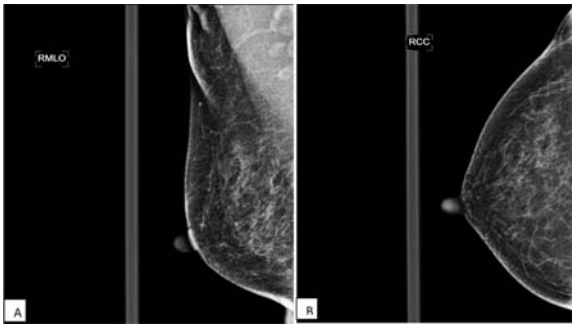

Fig. 2 Mammogram in MLO (A) and CC (B) views: The breast composition was categorized in group 2 by using the 4th edition of BI-RADS and in group B by using the 5th edition of BI-RADS.

agreement while the interobserver agreement between two radiologists (reader 2 and reader 3) was good (substantial). This result was probably due to different experience in interpretation between radiology resident and radiologists and resident might be more familiar with the 4th edition of BI-RADS than the new edition. The other reason was probably due to the fact that the 5th edition of BI-RADS uses subjective evaluation of breast density by the highest density area which might cause variation between readers. On the other hand, using percentage of fibroglandular tissue to measure breast composition in the 4th edition of BI-RADS is quantitative measurement therefore this edition is more satisfied and reliable for both new and experienced readers. The intraobserver agreement of breast composition assessment of the 5th edition of BI-RADS of both radiology resident and radiologist was also high.

There was no association of breast composition and occurrence of breast cancer in the 5th edition of BI-RADS categorization. This result was probably due to the fact that the 5th edition of BIRADS categorizes breast density by the densest part of the breast not by the percentage of fibrogranular tissue. However the number of cases might be too small.

Conclusion

The authors found no significant difference of breast composition distribution between the 4th edition and the 5th edition of BI-RADS and high correlation of interpretation by radiology resident and radiologist. The 5th edition of BI-RADS also had good interoserver and intraobserver agreement among radiologists for breast composition assessment.

This new method can be used well to assess breast composition by radiologists. The radiology residents need to acquaint themselves with this new BI-RADS edition.

What is already known on this topic?

There was high interobserver agreement of the 4th edition of BI-RADS in other studies and most of women had high density of breast composition.

What this study adds?

This research compared the changing of breast composition assessment between the previous and the latest editions of BI RADS and there were only few studies on this subject. In this research the authors found high correlation of breast composition of two editions by both readers, and that the new edition can replace the previous edition. In addition, authors compared interpretation of breast composition by using the new edition between radiology resident who has less experience in breast evaluation and higher experienced radiologists. The comparison revealed moderate to substantial interobserver agreement and high intraobserver agreement of the readers. Therefore, the breast composition in the 5th edition can be used by radiologists confidentially without machine calculation which has been used in some countries.

Potential conflicts of interest

None.

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การตรวจเอกซเรย์เต้านมเพื่อวัดความหนาแน่นของเต้านมในผู้หญิงไทยในโรงพยาบาลธรรมศาสตร์เฉลิมพระเกียรติ โดยการเปรียบเทียบระหว่างการใช้ the 4th and the 5th edition of ACR BI-RADS

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ภูมิหลัง: ในปัจจุบันวิธีประเมินความหนาแน่นของเต้านมได้มีการเปลี่ยนแปลงไปตามการตีพิมพ์ฉบับล่าสุดของ American College of Radiology คือ the 5th edition of BI-RADS

จุดประสงค์: เปรียบเทียบความหนาแน่นของเนื้อเต้านมระหว่างฉบับที่ 4 และฉบับที่ 5 ของ BI-RADS และการประเมินความแม่นยำของผู้อ่านแปลผลความหนาแน่นของเต้านมในฉบับที่ 5

วัสดุและวิธีการ: การเก็บข้อมูลโดยการสุ่มเลือกผู้ป่วย 300 คนที่มาตรวจเอกซเรย์เต้านมในช่วงเดือนมกราคม พ.ศ. 2556 จนถึงธันวาคม พ.ศ. 2556 โดยเปรียบเทียบความหนาแน่นของเนื้อเต้านมระหว่างฉบับที่ 4 และฉบับที่ 5 และศึกษา interobserver and intraabserver agreement ของความหนาแน่นเนื้อเต้านมของฉบับที่ 5 ระหว่างกลุ่มผู้อ่าน

ผลการศึกษา: ผลที่ได้รับพบ high correlation ของความหนาแน่นของเนื้อเต้านมระหว่างฉบับที่ 4 และฉบับที่ 5 ส่วนการศึกษาความหนาแน่นเนื้อเต้านมฉบับที่ 5 พบว่า interobserver reliability analysis อยู่ในระดับปานกลางและระดับสูงรวมทั้ง intraobserver reliability agreement ของผู้อ่านอยู่ในระดับสูงถึงสูงมาก

สรุป: ไม่พบความแตกต่างอย่างมีนัยสำคัญของการแบ่งความหนาแน่นของเนื้อเต้านมระหว่างการใช้วิธีของฉบับที่ 4 และฉบับที่ 5 รวมทั้ง interobserver agreement ของการแปลผลความหนาแน่นของเนื้อเต้านมของฉบับที่ 5 ระหว่างรังสีแพทย์อยู่ในระดับดี