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A self-directed learning intervention for radiographers rating mammographic breast density

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ABSTRACT

Purpose: Subjective methods of mammographic breast density (MBD) assessment are prone to inter-reader variability. This work aims to assess the impact of a short self-directed, experiential learning intervention on radiographers' reproducibility of MBD assessment.
Method: The study used two sets of images (test and learning intervention) containing left craniocaudal and left mediolateral oblique views. The test set had MBD ratings from Volpara™ and radiologists using the fourth edition Breast Imaging and Data Systems (BI-RADS®). Seven radiographers rated the MBD of the test set before and after a self-directed learning intervention using the percentage descriptors in the fourth edition BI-RADS® Atlas. The inter-reader agreement, the agreement between radiographers and Volpara™ as well as radiologists, was assessed using a Weighted Kappa (κ_W).
Results: Overall, radiographers' inter-reader agreement (κ_W) was substantial (0.79; 95% CI: 0.70–0.87) before the intervention and almost perfect (0.84; 95% CI: 0.77–0.90) after the intervention. Before the intervention, radiographers demonstrated fair agreement with radiologists (0.24; 95% CI: −0.46–0.61) and Volpara™ (0.24; 95% CI: −0.41–0.59). A fair but slightly improved agreement was also observed between radiographers and radiologists (0.31; 95% CI: −0.33–0.64) as well as Volpara™ (0.28; 95% CI: −0.34–0.61) after the intervention.
Conclusion: Findings demonstrate that a short duration self-directed, experiential learning intervention reduces inter-reader differences in MBD classification, but has a negligible impact on improving the agreement between inexperienced and expert readers.

Introduction

The proportion of dense tissue in a woman's breast is associated with the risk of developing breast cancer.[1,2] Women with extremely dense breasts have a 4–6 fold higher risk of developing breast cancer compared to those with an almost fatty breast.[1,2] Breast density is also associated with traditional risk factors for breast cancer such as genetic, reproductive and lifestyle characteristics.[3,4] The combination of breast density information with these risk factors has been shown to improve breast cancer risk prediction models.[5,6] Also, breast density reduction over time is associated with a reduced risk of developing breast cancer, and intake of vegetables and Vitamin D is associated with lower breast density.[7] Therefore, clinical mammographic breast density (MBD) assessment may be relevant for generating cancer risk profile and tailoring interventions to reduce risk.

High MBD increases the risk of interval cancer (cancer detected within one year of a negative mammography screening outcome) and reduces the sensitivity of screening mammography.[1,8] Interval cancer is linked to the high risk of cancer and the masking (camouflaging) effect due to tissue superimposition on two-dimensional (2D) mammography.[1,3] To mitigate the effects of MBD on cancer detection, imaging tools with 3D or pseudo-3D capabilities such as 3D ultrasound, digital breast tomosynthesis (DBT), and magnetic resonance imaging (MRI) have been introduced as adjuncts to mammography.[3] There is increasing advocacy

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for women to be notified of their breast density status, which has given rise to federal legislation in the USA mandating radiologists to produce breast density report.[9] This is because identifying women with dense breasts may facilitate informed decisions regarding appropriate imaging pathways that may improve early detection of cancer in such women. Therefore, it is important that MBD assessment approaches are reproducible to ensure that clinical decisions regarding adjunctive imaging and screening frequency are made consistently.

Of the methods developed for MBD assessment,[3,10] subjective (visual) approaches such as BI-RADS® are the most commonly used clinically.[3] A major limitation of subjective MBD assessment is reader intra and inter-reader variability,[3,10] which has the potential to cause differences in clinical decision-making from MBD data. Volumetric methods have now been integrated into the MBD reporting framework to overcome human subjective variability and include Volpara™ and Quantra™.[3,10] However, these tools are expensive and require additional computer servers to function,[3] and are therefore not an option for price sensitive healthcare systems. This, therefore, increases dependency on subjective approaches for clinical MBD classification. Previous studies have recommended training and retraining for MBD assessors to reduce BI-RADS® inter and intra-reader variability.[11,12] Experiential learning is a long-established training methodology for developing competence in medicine, health and other fields.[13,14] It involves observation of events or tasks, reflection and self-directed learning with the aim of developing competence suitable for practice.[13,15] Literature shows that experiential learning which contains approaches such as training and mentorship, hands-on practice, self-directed learning and appropriate immediate feedback mechanisms with self-reflection can be effective in developing competence in students and novice practitioners.[14–16] No study has assessed the impact of a short training intervention with feedback on the reproducibility of subjective MBD assessment. Consequently, in our study, we used a self-directed short computer-based experiential learning intervention with expert feedback in order to facilitate personal reflection and improve performance in the classification of MBD. If effective, short interventions might be hosted online to provide e-Learning support for radiographers and others to develop and maintain competence in MBD assessment. In today's economically limited environment a learning approach such as this would be an important cost-effective asset.

In the United Kingdom (UK), radiographers are heavily involved in screening mammography interpretation and imaging decision-making.[17] Although advanced practitioner and consultant radiographers' cancer detection performance in mammography interpretation is comparable to radiologists,[18] there is no data regarding their knowledge and inter-reader agreement in MBD assessment. Also, no study has assessed MBD agreement between radiographers and radiologists as well as other established MBD assessment approaches such as Volpara™. Consequently, the current work aims to assess inter-reader agreement of radiographers in MBD assessment and the impact of a self-directed, experiential learning exercise, with expert feedback on inter-reader agreement. It also aims to assess the agreement between radiographers and radiologists as well as Volpara™, and whether a self-directed, experiential learning exercise, with expert feedback, would improve radiographers' agreement with radiologists and Volpara™.

Methods

Institutional Review Board approval was granted for this study (IRB: 2013/448 and HREC protocol number 2014/905). The study was carried out in three phases; pre-test MBD assessment, intervention, and post-test MBD assessment. The pre- and post-test images were viewed on a 5 Megapixel Barco (Kortrijk, Belgium) self-calibrating 21 "display (MDNG − 5121). The ambient lighting was controlled between 20 and 30 lux. The learning intervention images were viewed on Dell (P2217H) 21.5" Full HD IPS LED displays.

Participants

Nine qualified radiographers were approached to participate. These radiographers held specialist postgraduate qualifications in mammography imaging practice. Also, they were nine months through an 11-month postgraduate university course which prepared them for the reporting of mammography images within the National Health Service Breast Screening Program (NHSBSP). Seven volunteered and gave consent to participate in the study. Participants completed a demographic questionnaire and then undertook the pre-test, the educational intervention, and the post-test MBD assessment.

Image selection

Two sets of images were selected, a test set and a learning intervention set. The same test set was used for the pre- and post-intervention MBD assessment. It comprised of 40 cases, each having three images: a left craniocaudal (LCC), left mediolateral oblique (LMLO), and a combination of LCC and LMLO presented together. These images were obtained from 40 women aged between 50 and 74 years, and they were drawn from an American mammography screening database. All images were reported as normal (negative for cancer), with the women being returned for normal screening. All women consented to use of their images for research. The 40 cases had Volpara™ volumetric breast density (VDG) scores and the majority BI-RADS® report of 20 American Board of Radiology (ABR) examiners. The majority report in the current study refers to the consensus of at least 11 out of the 20 ABR radiologists. The learning intervention set comprised of 100 mammographic images containing CC views, with their MBD ratings by a group of three expert radiologists using the percentage descriptors in the fourth edition BI-RADS® Atlas (1: less than 25% dense; 2: 25%–50%; 3: >50%–75%; 4: >75%). The intervention set provided participants with immediate feedback on their rating of MBD, while participants received no feedback on their pre- or post-test performance.

Pre-intervention MBD assessment

The test set was used for the pre-intervention MBD assessment. All seven participants independently classified MBD of the cases into different percentages as described by the fourth edition BI-RADS® Atlas (1: less than 25% dense; 2: 25%–50%; 3: >50%–75%; 4: >75%). Participants were told not to pan, zoom or change window settings as the study was not a lesion detection task. We recorded the MBD rating of each participant and generated a majority report. The majority report in this study represents the consensus of at least four of the seven participants involved in the reading. No feedback on performance was provided to participants at the end of the assessment. The readings of the participants were compared in pairs to assess their inter-reader agreement before the intervention. We also compared the majority report of participants to that of the ABR examiners (radiologists) as well as the VDGs assigned by Volpara™ to assess their agreement with these alternative measures prior to the intervention.