



Implementing supplementary breast cancer screening in women with dense breasts: Insights from European radiographers and radiologists

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ARTICLE INFO

Article history:

Received 6 February 2024

Received in revised form

28 March 2024

Accepted 2 April 2024

Keywords:

Breast cancer screening

Dense breasts

Radiographers perspectives

Radiologists insights

Supplementary screening challenges

Multifaceted screening solutions

ABSTRACT

Introduction: In response to the critical need for enhancing breast cancer screening for women with dense breasts, this study explored the understanding of challenges and requirements for implementing supplementary breast cancer screening for such women among clinical radiographers and radiologists in Europe.

Method: Fourteen (14) semi-structured online interviews were conducted with European clinical radiologists (n = 5) and radiographers (n = 9) specializing in breast cancer screening from 8 different countries: Denmark, Finland, Greece, Italy, Malta, the Netherlands, Switzerland, United Kingdom. The interview schedule comprised questions regarding professional background and demographics and 13 key questions divided into six subgroups, namely Supplementary Imaging, Training, Resources and Guidelines, Challenges, Implementing supplementary screening and Women's Perspective. Data analysis followed the six phases of reflexive thematic analysis.

Results: Six significant themes emerged from the data analysis: Understanding and experiences of supplementary imaging for women with dense breasts; Challenges and requirements related to training among clinical radiographers and radiologists; Awareness among radiographers and radiologists of guidelines on imaging women with dense breasts; Challenges to implement supplementary screening; Predictors of Implementing Supplementary screening; Views of radiologists and radiographers on women's perception towards supplementary screening.

Conclusion: The interviews with radiographers and radiologists provided valuable insights into the challenges and potential strategies for implementing supplementary breast cancer screening. These challenges included patient and staff related challenges. Implementing multifaceted solutions such as Artificial Intelligence integration, specialized training and resource investment can address these challenges and promote the successful implementation of supplementary screening. Further research and collaboration are needed to refine and implement these strategies effectively.

Implications for practice: This study highlights the urgent need for specialized training programs and dedicated resources to enhance supplementary breast cancer screening for women with dense breasts in Europe. These resources include advanced imaging technologies, such as MRI or ultrasound, and specialized software for image analysis. Moreover, further research is imperative to refine screening protocols and evaluate their efficacy and cost-effectiveness, based on the findings of this study.

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Introduction

Breast cancer is the most prevalent cancer in women and ranks as the third leading cause of cancer-related fatalities in Europe¹. In an effort to reduce breast cancer mortality through early detection, many countries have implemented mammography breast cancer screening programs.^{2,3} Research indicates that Full-field digital mammography (FFDM) can contribute to a 20% reduction in mortality rates from breast cancer. The sensitivity of screening FFDM

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ranges between 77% and 95%, with a specificity of 94–97% across all age groups.^{4–6} Despite these advancements, concerns persist regarding the equitable distribution of benefits among all women, particularly in identifying breast cancer in denser breast tissues^{7,8}.

Breast density, reflecting the relative composition of radiopaque epithelial and stromal tissues compared to radiolucent fatty components visible on FFDM, is a critical factor. Women with dense breasts have a higher proportion of fibrous and glandular tissue and a reduced amount of fat tissue⁹. Approximately 40% of women have heterogeneously dense breasts, and around 10% have extremely dense breasts, collectively representing roughly 50% of women undergoing screening^{10–12}. The heightened mammographic density in women with heterogeneously or extremely dense breast tissue diminishes the sensitivity of FFDM due to masking effects, leading to increased false positives from the superimposition of dense parenchyma¹³.

High breast density independently emerges as a potent risk factor for breast cancer, with women having denser breasts exhibiting a three to six times higher probability of developing breast cancer compared to those with fatty breasts^{5,11}. Acknowledging the reduced sensitivity of FFDM in detecting breast cancer among such women, supplemental imaging modalities have been introduced as adjunct investigations^{12,14}. Over the past decade (2014–2024), several large-scale studies have published results demonstrating enhanced breast cancer detection and reduced interval cancer rates associated with supplemental screening for such women^{15–18}.

While supplemental imaging modalities prove advantageous in assessing dense breast tissue, it is essential to consider the distinct pros and cons associated with each type of diagnostic test^{19,20}. Common supplemental imaging modalities utilized in breast cancer screening include magnetic resonance imaging (MRI), ultrasound, and digital breast tomosynthesis (DBT).¹⁸

MRI offers high sensitivity in detecting breast cancer, particularly in dense breast tissue, because of its high soft tissue delineation capabilities making it a valuable tool for screening. However, its drawbacks include high cost, longer examination times, and lower specificity due to its limitation in detecting microcalcifications, which may lead to increased false positives. Ultrasound, on the other hand, is more widely accessible and cost-effective compared to MRI. It provides real-time imaging and is particularly useful in distinguishing between solid masses and cysts. However, its sensitivity in detecting small breast lesions is lower compared to MRI, and it may miss certain types of lesions. Ultrasound is also operator dependent and relies on the skills and competencies of the health care professional performing the scan. Digital breast tomosynthesis (DBT), has gained popularity as an adjunct to conventional mammography. It offers improved cancer detection rates and reduced recall rates compared to 2D mammography since DBT is a cross-sectional imaging modality resolving issues of superimposition. However, like MRI, DBT is associated with higher costs and increased radiation exposure²⁰.

Additionally, studies conclude that more cancers are detected with supplementary screening for such women, leading to increased recalls for additional imaging and biopsies.^{15,18,21} Thus, despite the growing body of evidence supporting the benefits of supplemental screening in dense breasts, there are significant capacity and resource considerations to address when implementing these screening methods. There exists a knowledge gap concerning the specific requirements needed to implement supplementary screening in such women across various European countries.^{13,18,20} To address this gap, this study was conducted to gain a more in-depth understanding of the specific requirements for implementing supplementary screening in such women across different European countries.

Methods

Design, sampling and data collection

The study employed a phenomenological methodology to gain a deeper understanding of the prerequisites for implementing supplemental breast cancer screening for such women across European countries. The phenomenological approach concentrated on delving into the experiences of participants regarding the subject matter, interpreting their responses to attain a more profound comprehension of the phenomenon under investigation.²² The study consisted of semi-structured on-line interviews with European clinical radiologists and radiographers working in breast cancer screening. Semi-structured interviews provided a flexible way to elaborate more on the information given by the participants to the common key questions, that aid to explore the area being investigated^{23,24}. The interviews with participants were held on-line using Microsoft Teams Software. The data collection period was from June till December 2021. The aid of the European Federation of Radiography Societies (EFRS), the European Society of Breast Imaging (EUSOBI) and DenseBreast-info organisation was sought to circulate an email amongst their members with information on the research study to be able to recruit participants. EFRS, EUSOBI and DenseBreast-info organisation were selected due to the large number of members who are health care professionals in the field of breast imaging all over Europe. The snowballing sampling technique was also used to help recruit further participants for the study. The study aimed to include participants from ten countries, with approximately five individuals from each. Despite not meeting the planned sample size, the smaller sample remained representative of multiple countries, ensuring similar impacts on results and interpretations of findings.

The semi-structured interview schedule consisted of a set of opening questions together with 13 key questions, divided into six subgroups, namely Supplementary Imaging, Training, Resources and Guidelines, Challenges, Implementing supplementary screening and Women's Perspective, that were asked to each of the interviewed professionals (Fig. 1). The key questions were developed over a period of time and were informed by the preliminary literature review that revealed similar previous studies and questions used.^{25,26} The only risk factor considered in this study was breast density.

Pilot study summary

A pilot interview was also conducted to gain the skills needed for the data collection phase and to obtain an expert viewpoint and feedback on the appropriateness of the questions being asked and the practicality and feasibility of the interview procedure carried out online.²⁷ The pilot interview was carried out with a consultant radiographer from the United Kingdom, working in the field of breast cancer screening together with an academic expert in this field of breast cancer screening who works at a University in Switzerland. The pilot interview was also performed in the presence of an academic, knowledgeable in qualitative research. The extensive feedback received from the interviewees was used to further ensure the trustworthiness of the method that was adopted in this study. Following the pilot study, the prompt questions were revised to enhance inclusivity regarding various screening practices across Europe and to elicit more comprehensive responses from participants. An example of a modified prompt question is: "Which types of cancers are predominantly detected using supplementary imaging?" This question was tailored to inquire about all the different imaging modalities utilized for supplementary screening in women with dense breasts at the screening unit. Additionally, demographic questions were updated to specify the city/region in addition to the country.

Key Questions:

Supplementary Imaging

1. What is your understanding of supplementary imaging for women with dense breasts?
2. Within your screening unit, do you invite any women for supplementary imaging?

Training

3. Have you ever undergone any training specifically related to supplementary imaging for women with dense breasts or has this training been a significant part of more general training around breast screening?
4. Do you think more specialist training on this area would be useful?

Resources and Guidelines

5. Are you aware of any resources or guidelines relating to supplementary imaging for women with dense breasts?
6. Are you aware of the recently published European Commission breast cancer screening guidelines?
7. Can you please share your views on the recently published European Commission breast cancer screening guidelines for women with dense breasts?

Challenges

8. In your experience, are there any challenges to implementing supplementary screening in women with dense breasts?
9. Do you have any ideas or views for how some of these challenges could potentially be addressed?

Implementing supplementary screening

10. In your experience, do you believe that Digital breast tomosynthesis is an imaging modality that enhances the implementation of supplementary screening in women with dense breasts?
11. In your opinion, would health care professionals be willing to change practice to implement supplementary screening in women with dense breasts?

Women's Perspective

12. Can you please share your views on how women with dense breasts who undergo supplementary imaging view this tailored screening approach?
13. Can you please share your views on the resources that women might access relating to supplementary imaging for dense breasts?

Figure 1. Interview schedule.

Data analysis

Audio recording was used in this study, with each interview lasting approximately 30–60 min. The interview data was transcribed verbatim. Thematic data analysis was only initiated once each interview was transcribed, this process aided to focus more on the thematic procedure being conducted. The interviews were analysed through reflexive thematic analysis, during which significant statements were extracted to reach the objectives set for this study.²⁸ NVivo programme was used to extract the themes and facilitated the process of data analysis. The approach to reflexive thematic analysis encompassed a six-phase methodology. This process commenced with becoming acquainted with the dataset, followed by a meticulous and structured coding procedure. Subsequently, the analysis delved into the exploration, development, review, and refinement of themes, culminating in the creation of the written analytical report.²⁹ In the Results section, the quotes corresponding to themes and subthemes are presented in tables, following a format similar to a previous study published in this journal³⁰.

Research ethics

Ethical permission was attained from the University of Salford School of Health and Society Research Ethics Committee. The participants were given an information letter, detailing the research aim and objectives of this study and indicating that they could withdraw from the study at any time, or even choose not to respond to a particular question. The participants were also assured that their anonymity would be preserved, therefore care was taken not to disclose any personal details during the recording and the analysis of the data.

Results

Fourteen semi-structured interviews were conducted, from eight different countries. The countries were the United Kingdom, Malta, Italy, the Netherlands, Greece, Finland, Denmark and Switzerland. The participants were five radiologists and nine radiographers. Table 1 shows the demographics of each participant.

Through the thematic data analysis of the interviews six themes together with a number of subthemes emerged. Fig. 2 shows the

Table 1
Participants demographics.

Participant Number	Profession	Number of years working in breast cancer screening (yrs)	Number of years breast screening unit been running (yrs)	Location/Region of screening unit	Age range of invited women (yrs)	Number of women invited yearly for mammography screening	Number of women attending yearly for mammography screening	Type of funding of screening unit	Interview Duration (mins)
1	Radiographer	0–5	20	London, UK	50–70	Unknown by participant	50,000	Government	32
2	Consultant Breast Radiologist	0–5	20	Crete, Greece	40 onwards	Not applicable	10,000	Subsidised by government	41
3	Consultant Radiographer & Manager	6–10	20	London, UK	50–70	72,000	50,000	Government	50
4	Radiographer	0–5	10	South of Finland, Finland	50–69	Unknown by participant	10,000	Government	40
5	Radiographer	11 onwards	25	Emilia Romagna, Italy	45–74	25,000	21,000	Government	42
6	Radiographer & Manager	11 onwards	30	Turin, Italy	45–75	65,000	40,000	Government	60
7	Consultant Breast Radiologist	6–10	12	Valletta, Malta	50–69	20,000	13,000	Government	35
8	Radiographer & Manager	11 onwards	30	Odense, Denmark	50–69	65,000	50,000	Government	38
9	Breast Radiologist	6–10	20	Rome, Italy	50–74	40,000	20,000	Government	37
10	Consultant Breast Radiologist	6–10	20	East Worcestershire, UK	50–70	150,000	100,000	Government	48
11	Senior Radiographer	11 onwards	Not available	Athens, Greece	40 onwards	Not applicable	Unknown by participant	Subsidized by government	50
12	Breast Radiologist	11 onwards	Over 30	Netherlands	50–75	Not applicable	Not applicable	Government	30
13	Radiographer	11 onwards	20	Switzerland	50–75	Unknown by participant	Unknown by participant	Combination of public and private resources	55
14	Radiographer	6–10	20	Switzerland	50–74	Unknown by participant	Unknown by participant	Combination of public and private resources	41

Themes and Subthemes which were developed using the six phases of reflexive thematic analysis.

Theme 1: Understanding and experiences of supplementary imaging for women with dense breasts

Supplementary imaging for dense breasts is a topic under discussion and research in breast imaging (Table 2).

Subtheme 1.1: Additional imaging techniques or modalities following mammography

Participants highlighted using techniques like ultrasound, Magnetic Resonance Imaging (MRI), and Digital Breast Tomosynthesis (DBT) after mammography for women with dense breasts. These methods offer a more comprehensive breast tissue evaluation, detecting additional cancers and improving characterization of suspicious findings.

Subtheme 1.2: Mammography as first-line screening modality

Most participants stressed mammography as the primary screening for breast cancer, acknowledging its effectiveness in the general population. However, they recognized its limitations in dense breast tissue and advocated for supplementary imaging in this group.

Subtheme 1.3: Supplementary screening for women with dense breasts is beneficial

Participants unanimously agreed on the benefits of supplementary screening for women with dense breasts. Dense tissue can hide abnormalities on mammograms, making early-stage cancer detection challenging. Techniques like ultrasound and MRI improve cancer detection rates, emphasizing the importance of tailoring screening for high-risk individuals.

Subtheme 1.4: Supplementary screening is not current practice due to various reasons

Despite acknowledged benefits, participants noted limited adoption of supplementary screening for women with dense breasts. Challenges include restricted access to imaging, financial constraints, resource availability, and regional guideline variability. Concerns about false positives and unnecessary interventions warrant further research and consensus.

One participant mentioned their unit participating in a trial assessing whereby the aim was to assess the effectiveness of supplementary Automatic Breast Ultrasound (ABUS) examinations in women with BI-RADS D density, employing a random invitation approach.

Theme 2: Challenges and requirements related to training amongst clinical radiographers and radiologists

Effective supplementary screening implementation requires well-trained healthcare professionals (Table 3).

Subtheme 2.1: Negative aspects of training

Participants cited challenges in implementing supplementary screening training, including insufficient resources like computers and software. Limited accessibility to some training programs and political constraints were additional obstacles.

Subtheme 2.2: Positive aspects of attended training

Some participants praised accredited, freely available training programs, ensuring quality content and broader professional access.

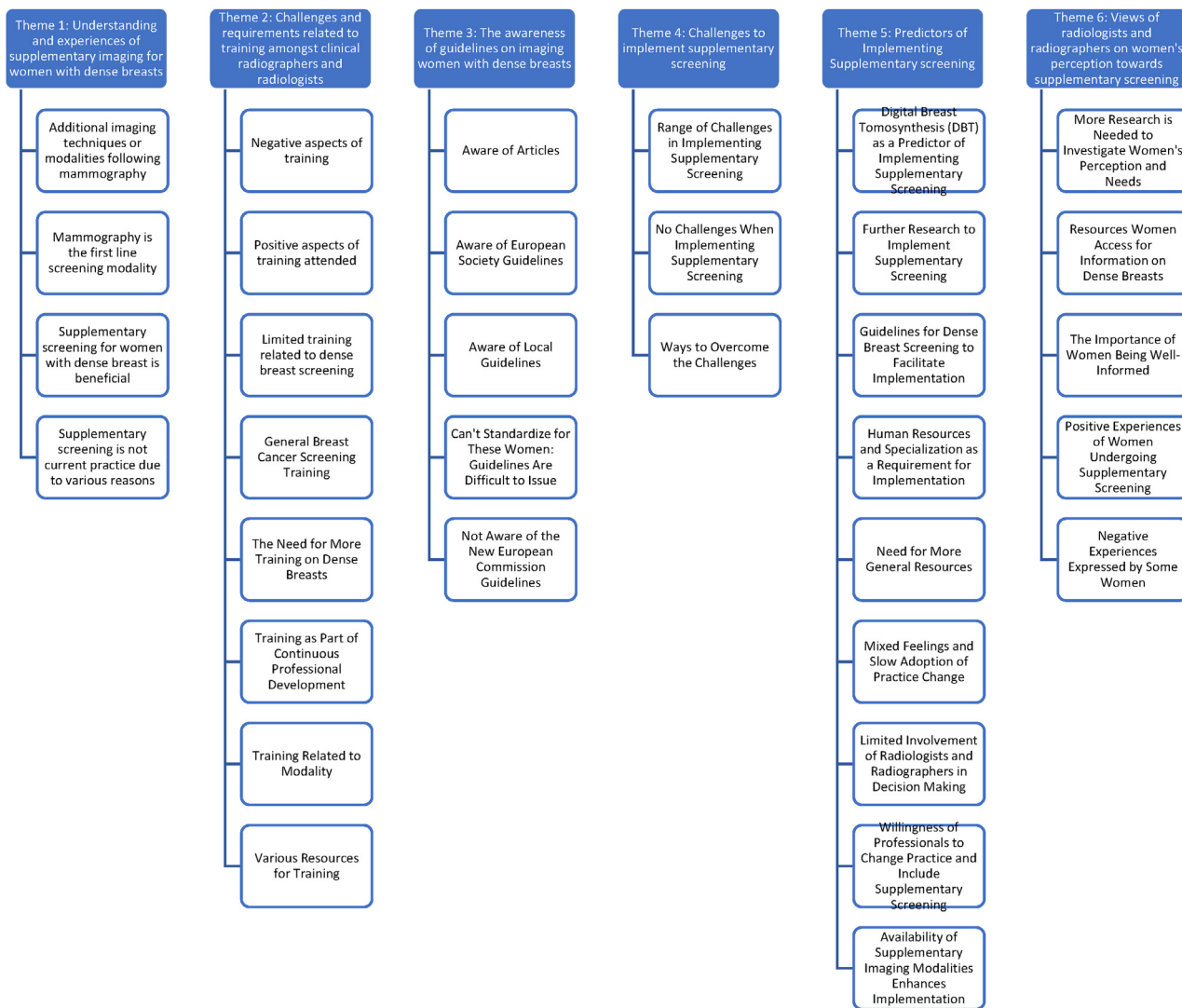


Figure 2. Diagram of thematic analysis themes and subthemes.

Subtheme 2.3: Limited training related to dense breast screening

Many participants lacked specific training on dense breast screening, highlighting a knowledge gap and the need for comprehensive programs addressing unique challenges.

Subtheme 2.4: General breast cancer screening training

While participants had general breast cancer screening training, it might not have sufficiently covered the intricacies of implementing supplementary screening.

Subtheme 2.5: The Need for more training on dense breasts

Consensus among participants emphasized the necessity for more focused training on dense breasts, covering technical aspects, risk assessment, interpretation of imaging modalities, patient communication, and decision-making.

Subtheme 2.6: Training as part of continuous professional development

Participants stressed ongoing training and continuous professional development, advocating for incorporating dense breast screening training into these programs.

Subtheme 2.7: Training related to modality

Training on specific supplementary imaging modalities, such as ultrasound and MRI, was deemed crucial for accurate interpretation, workflow optimization, and improved patient outcomes.

Subtheme 2.8: Various resources for training

Participants underscored the importance of diverse resources, including online courses, workshops, conferences, mentorship programs, clinical guidelines, case studies, and interactive tools, to enhance the effectiveness and accessibility of training programs.

Theme 3: The awareness of guidelines on imaging women with dense breasts

In recent years, dense breasts' impact on mammography screening gained attention, with the European Commission issuing specific guidelines (Table 4).

Subtheme 3.1: Aware of articles

Participants acknowledged valuable insights from articles and reputable sources, emphasizing the importance of staying updated for optimal patient care.

Table 2
Participants' quotes for theme 1.

Theme 1: Understanding and experiences of supplementary imaging for women with dense breasts		Participants' Quotes
Subthemes:	Additional imaging techniques or modalities following mammography	'.....ultrasound and possibly tomosynthesis and MRI would significantly improve the sensitivity and potentially even the specificity of imaging women with dense breasts.' (P3, Consultant Radiographer and Manager, UK) 'And when there is a really dense breast, so that the accuracy of mammography is decreased, with the ultrasound we can get more sensibility and specificity of the screening.' (P9, Breast Radiologist, Italy)
	Mammography is the first line screening modality	'So it would be imaging, added on to the mammogram, with the mammogram being the staple and the gold standard of, of assessment.' (P7, Consultant Breast Radiologist, Malta) 'Mammography is always to start with, and as supplementary, you can perform MRI that has been scientifically proven.' (P12, Breast Radiologist, Netherlands)
	Supplementary screening for women with dense breast is beneficial	'So basically, it's a way recognizing that screening mammograms have limitation in patients with dense breasts is a way of offering them a supplemental imaging which could be MRI or any of these mammographic imaging to overcome the limitation of the standard digital mammography.' (P10, Consultant Breast Radiologist, UK) '.....avoid what may be interval cancers.' (P5, Radiographer, Italy)
	Supplementary screening is not current practice due to various reasons	'There isn't enough evidence to suggest that we would potentially lower the mortality by providing ultrasound as an adjunct for dense breasts.' (P3, Consultant Radiographer and Manager, UK) 'but we wouldn't routinely invite them for supplementary imaging as well.' (P1, Radiographer, UK)

Table 3
Participants' quotes for theme 2.

Theme 2: Challenges and requirements related to training amongst clinical radiographers and radiologists		Participants' Quotes
Subthemes:	Negative aspects of training	'Because it's difficult to me online because in the hospital, we don't have so many computers' (P9, Breast Radiologist, Italy) 'Maybe it's not training that's needed. For example, in my country, they know that they need to do supplementary screening, but they need a political decision on as to what they're going to do because it's going to have consequences.' (P2, Consultant Breast Radiologist, Greece)
	Positive aspects of training attended	'CME accredited. CME accredited is, is something that especially, EUSOBI, makes sure that, if there's any good training happening, that they'll, they'll want to make, to give it a standard.' (P7, Consultant Breast Radiologist, Malta). 'Sometimes it's free.' (P9, Breast Radiologist, Italy)
	Limited training related to dense breast screening	'I think more training for all will be better.' (P13, Radiographer, Switzerland). 'No, not specifically, I mean, density is mentioned all the time, but not specifically as part of my training' (P3, Consultant Radiographer and Manager, UK)
	General Breast Cancer Screening Training	'We have a course for screeners, especially for screeners, which depending on the municipality agreement, they can demand that people who are screening they have to go undergo this course. But regarding this imaging for dense breasts, there is no curricula yet for that.' (P4, Radiographer, Finland)
	The Need for More Training on Dense Breasts	'I think we need a bit of a better understanding of how the exposure actually affects the image quality, and also, I think in the same way that we are discussing here, image quality but also what else we can do because of those image quality limitations. I think more work needs to be done on the technical aspects or on the physical aspect of acquiring that image.' (P3, Consultant Radiographer and Manager, UK)
	Training as Part of Continuous Professional Development	'I'm a member of the EUSOBI, and I'm a member of the BSBR Society as well. So I tend to attend the conferences.' (P2, Consultant Breast Radiologist, Greece) 'Yeah, individually, I've done several additional courses that would discuss breast cancer, sorry, breast density, and potential other modalities to use in breast density. And I've also done courses related to risk, which is not a specific requirement for my role.' (P3, Consultant Radiographer and Manager, UK)
	Training Related to Modality	'So in an ideal world, it would be nice to train more people in doing MRI and in reading abbreviated MRI protocol for screening ladies.' (P10, Consultant Breast Radiologist, UK) '.....have a bit of an overview, especially in ultrasound, just to understand what the doctors are looking at and what correlates to the mammogram itself.' (P1, Radiographer, UK)
	Various Resources for Training	'If it's something general to understand something, it could be online. But after, when it has to be on the positioning, my idea is that you have to feel it under your hand.' (P13, Radiographer, Switzerland). 'If you're training radiologists, which they got already a knowledge about basics MRIs and what MRI is, you can probably- I think would like it to be a blended way of doing it. Probably, I don't know, the more theory part, of course, can be done online. But the practical bits are- actually like the reading sessions and whatsoever probably needs to be face to face or with somebody to ask question. So advising you. I think I probably will like a mixture of remote and face-to-face training.' (P10, Consultant Breast Radiologist, UK)

Table 4
Participants' quotes for theme 3.

Theme 3: The awareness of guidelines on imaging women with dense breasts	Participants' Quotes
Subthemes:	
Aware of Articles	'Yeah, I see that in a journal, and I see it's important for make ultrasound for the radiologist. I see that in article.' (P14, Radiographer, Switzerland)
Aware of European Society Guidelines	'Well, I remember the position paper of the European Society of Breast Imaging recommended additional imaging for women with dense breasts, and that's what I use for my practice.' (P2, Consultant Breast Radiologist, Greece)
Aware of Local Guidelines	'Well, I know that in Austria there has been a guideline, but I don't know whether it's a real guideline, yes or no, that women with dense breasts are offered an additional ultrasound.' (P12, Breast Radiologist, Netherlands)
Can't Standardize for These Women: Guidelines Are Difficult to Issue	'But, in my opinion, it's also because of what I was saying before. Why standardize ... is perhaps the exam you can least standardize in some respects.' (P5, Radiographer and Manager, Italy)
Not Aware of the New European Commission Guidelines	'I wouldn't know personally, but I don't think PHE, like Public Health England– I don't think they do.' (P1, Radiographer, UK)
	'Well, in screening there isn't yet protocol for that breast. So it's like for fat breast. So mammograms and if you see something, ultrasound biopsy. Otherwise, only mammograms.' (P9, Breast Radiologist, Italy)

Subtheme 3.2: Aware of European Society guidelines

Several participants were knowledgeable about EUSOBI guidelines, appreciating their valuable insights for imaging women with dense breast tissue.

Subtheme 3.3: Aware of local guidelines

While some participants knew local guidelines, variability across countries suggested inconsistent awareness and implementation. Factors influencing guidelines included healthcare infrastructure, resource availability, and regional breast cancer prevalence.

Subtheme 3.4: Can't standardise for these women: guidelines are difficult to issue

Participants highlighted challenges in standardizing guidelines for women with dense breasts due to varying tissue composition. Factors like breast density classification, imaging modalities, and risk stratification complicated comprehensive guideline development. Personalized approaches considering individual characteristics and risk factors were emphasized.

Subtheme 3.5: Not aware of the new European Commission Guidelines

Several participants were unaware of the new European Commission Guidelines, indicating potential reasons such as limited information dissemination, lack of access, or inadequate communication channels. The findings suggest a need for better awareness campaigns and targeted guideline dissemination in the European breast imaging community.

Theme 4: Challenges to implement supplementary screening

Implementing supplementary screening for women with dense breasts presents numerous challenges across European countries (Table 5).

Subtheme 4.1: Range of challenges in implementing supplementary screening

Following is the list of challenges that emerged from the above subtheme:

- **Cost and Logistics Problems:** Financial constraints, high costs of imaging modalities, and infrastructure requirements hinder widespread implementation. Logistic issues, limited equipment availability, and the need for specialized personnel complicate the process.

- **Modality-Related Challenges:** Specific imaging modalities, like ultrasound or MRI, face challenges such as limited accessibility, variations in interpretation, and the need for specialized training.
- **Need for Further Research:** Participants stressed the need for evidence-based guidelines, cost-effectiveness evaluations, and more research to address knowledge gaps.
- **Patient-Related Challenges:** Patient acceptance, compliance, and understanding pose challenges due to limited awareness, concerns about false positives, and anxiety related to additional tests.
- **Political Challenges:** Inconsistent healthcare policies and regulations across regions affect implementation, leading to disparities in access and funding.
- **Staff-Related Challenges:** Limited human resources, especially radiologists and radiographers with specialized training, challenge successful implementation.
- **Time Constraints in Reporting and Conducting Additional Imaging:** Incorporating supplementary screening may increase workload and create time constraints; efficient workflow and timely reporting systems were suggested solutions.

Subtheme 4.2: No challenges when implementing supplementary screening

Some participants reported successful implementation without challenges, citing established protocols, adequate resources, and training as key factors.

Subtheme 4.3: Ways to overcome the challenges

Following are the list of ways that emerged to overcome the challenges:

- **Artificial Intelligence (AI):** Using AI for risk assessment, image interpretation, and decision support to enhance efficiency and resource utilization.
- **Consensus Meetings and Guidelines:** Collaborative efforts, consensus meetings, and standardized guidelines to provide a framework for implementation.
- **Patient Education:** Crucial for promoting patient acceptance through clear communication, informed consent, and shared decision-making.
- **More Human Resources and Increased Salaries:** Attracting and retaining specialized healthcare professionals through competitive salaries and incentives.
- **Insurance Coverage and Financial Support:** Advocating for insurance coverage and financial support to overcome cost-related challenges.

Table 5
Participants' quotes for theme 4.

Theme 4: Challenges to implement supplementary screening	Participants' Quotes
Subthemes: Range of Challenges in Implementing Supplementary Screening	'Well, the challenges are, as has been the challenges for forever with ultrasound and with MRI, it is the accessibility of those two modalities and the cost of providing supplementary imaging for dense breasts. Also, it is the logistics of how to do it because screening is undertaken as a two-phase, at least as a basis a two-phase service so women are screened with mammography and they come for mammography, so the only individual and the only professional they meet at that point in time is the radiographer.' (P3, Consultant Radiographer and Manager, UK) 'Well, I think it's an issue of funding and time, especially if it was ultrasound, that would be very costly and there wouldn't be enough radiologists to do the ultrasounds.' (P4, Radiographer, Finland) 'You can't perform easily MRI because it's an expensive exam. And we don't have so many MRIs.' (P11, Senior Radiographer, Greece).
No Challenges When Implementing Supplementary Screening	'No, not now. Almost all operating units and mammography machines that are purchased are equipped with tomosynthesis.' (P5, Radiographer, Italy) 'We have the quality of the operators, dedicated screening and so on. And when we can also offer Rolls Royce it is obvious that one does tomosynthesis, does ABUS, does all these things here.' (P6, Radiographer and Manager, Italy)
Ways to Overcome the Challenges	'So there are now quite a lot of artificially intelligent functions that can provide a reading on breast density in mammography. So if we can implement something like that, so then we know which breasts are very dense. And then look at maybe a way of providing additional imaging using different modalities for those women, so rather than the clinician doing that interpretation of density, whether there's an automated way of giving you the outcome, so I'm talking about things like Volpara or Quantra.' (P3, Consultant Radiographer and Manager, UK) 'And I think having the right amount of doctors or radiographers all trained up in those supplementary areas. We are very short-staffed, so trying to entice people to go and do it, and then carrying it out. So yeah, staffing would probably be one of the problems, cost, so yeah.' (P1, Radiographer, UK)

- **Investment in Equipment and IT Resources:** Adequate investment in imaging equipment, infrastructure, and IT resources to address logistical challenges.
- **Enhanced Communication and Collaboration Amongst Health Professionals:** Improved communication and collaboration among health professionals for seamless implementation.
- **More Specialisation and Training:** Specialized training programs and ongoing professional development for expertise in breast imaging.
- **Personalised Screening and Risk Stratification:** Tailoring screening strategies based on individual patient characteristics and risk assessment models.
- **Protocols and Quality Assurance:** Standardized protocols, quality assurance measures, and regular audits for consistency and reliability.
- **Reduction in Interval Cancers:** Achieving a reduction in interval cancers through effective screening programs and early detection as a crucial outcome justifying supplementary screening implementation.

Theme 5: Predictors of Implementing Supplementary screening

Supplementary screening is crucial in breast imaging to enhance cancer detection rates (Table 6).

Subtheme 5.1: Digital breast tomosynthesis (DBT) as a predictor of implementing supplementary screening

Participants identified DBT as a promising predictor for supplementary screening. Its enhanced visualization and diagnostic accuracy in dense breast tissue make it valuable in supporting implementation.

Subtheme 5.2: Further research to implement supplementary screening

Participants stressed the need for additional research on the effectiveness and outcomes of ultrasound and MRI in dense breast populations to inform evidence-based guidelines and decision-making for supplementary screening.

Subtheme 5.3: Guidelines for dense breast screening to facilitate implementation

Clear and standardized guidelines were deemed crucial for facilitating supplementary screening implementation. Multidisciplinary collaboration was emphasized for guideline development, considering risk stratification, patient characteristics, and available resources.

Subtheme 5.4: Human resources and specialization as a requirement for implementation

Adequate human resources and specialization, particularly in radiologists and radiographers, were recognized as critical for successful supplementary screening implementation.

Subtheme 5.5: Need for more general resources

Participants highlighted the necessity for additional general resources, including financial support and equipment availability, to overcome barriers like limited access to advanced imaging technologies.

Subtheme 5.6: Mixed feelings and slow adoption of practice change

Professionals' mixed feelings, resistance to change, and concerns about increased workload were noted as factors contributing to slow adoption. Effective communication and awareness campaigns were suggested to address these challenges.

Subtheme 5.7: Limited involvement of radiologists and radiographers in decision making

Limited involvement of radiologists and radiographers in decision-making processes was reported. Participants stressed the importance of including these professionals in policy development forums for their expertise and perspectives.

Subtheme 5.8: Willingness of professionals to change practice and include supplementary screening

Despite challenges, participants expressed a general willingness to change practice and include supplementary screening, acknowledging its potential benefits. Proper training, support, and resources were emphasized for this practice change.

Table 6
Participants' quotes for theme 5.

Theme 5: Predictors of Implementing Supplementary screening	Participants' Quotes
Subthemes: Digital Breast Tomosynthesis (DBT) as a Predictor of Implementing Supplementary Screening	'I think it's good. I think it's good to use breast tomosynthesis to implement the accuracy of diagnostic imaging breasts in dense breasts.' (P9, Breast Radiologist, Italy)
Further Research to Implement Supplementary Screening	'I think yes, tomosynthesis has the potential of helping in assessing dense breasts, and if we prove that we can provide the same level of screening, potentially at the same cost and at the same radiation dose, using tomosynthesis as the first-line screening, then potentially we can improve our cancer detection rate in dense breasts.' (P3, Consultant Radiographer and Manager, UK)
Guidelines for Dense Breast Screening to Facilitate Implementation	'And if there's done more and more studies about it, that it has efficiency for the women, then I think we would just make it happen.' (P8, Radiographer and Manager, Denmark)
Human Resources and Specialization as a Requirement for Implementation	'We do have ultrasound the scan machines. It's not a problem. And doctors. It's uniformity of practice that we need in Greece. Not staff or resources. Uniformity of practice is what will make a difference.' (P2, Consultant Breast Radiologist, Greece)
Need for More General Resources	'You need to allow more time to take your tomosynthesis. You need to train radiographer. You need to train film readers. It will double the time you need to read the standard mammography. And it will require training as well, as I said. And I'm sure, at the beginning, it will probably have impact on the recall rate as well, as well as an MRI.' (P10, Consultant Breast Radiologist, UK)
Mixed Feelings and Slow Adoption of Practice Change	'I think you would need a lot more ultrasound machines, a lot more room at the hospital for the ultrasound machines, and rooms just so you could do the supplementary imaging for these ladies, yes.' (P1, radiographer, UK)
Limited Involvement of Radiologists and Radiographers in Decision Making	'Okay, so I think you will have a mixed reaction based on individuals' inclinations. Somebody who was like me, which I'm very big fan of MRIs will be very keen on embracing this. Some others will probably be less. But I think if this becomes guidelines - and we all need to implement additional screening - If we offer additional screening to our screening population, I think in the long term with very good planning of resources and staff, everybody will embrace it.' (P10, Consultant Breast Radiologist, UK)
Willingness of Professionals to Change Practice and Include Supplementary Screening	'Well, they're not deciding that. It's the government who decides that. So they just have to follow the guidelines from the government.' (P12, Breast Radiologist, Netherlands)
Availability of Supplementary Imaging Modalities Enhances Implementation	'I think the willingness to change practice is there because we understand the challenge of reading a dense mammogram and also we understand that it is more difficult to find cancer in dense breast.' (P3, Consultant Radiographer and Manager, UK)
	'Well, I think, again, in the very dense breasts, you still have issues. So perhaps I think the MRI would be a good approach.' (P11, Senior Radiographer, Greece)

Subtheme 5.9: Availability of supplementary imaging modalities enhances implementation

The availability of supplementary imaging modalities, such as ultrasound and MRI, was recognized as a key facilitator for implementing supplementary screening, ensuring comprehensive and effective screening for women with dense breasts.

Theme 6: Views of radiologists and radiographers on women's perception towards supplementary screening

Understanding women's perception and needs regarding supplementary screening is crucial for effective breast cancer screening programs (Table 7).

Subtheme 6.1: More research is needed to investigate Women's perception and needs

Participants emphasised the need for further research to investigate women's perception and needs when undergoing supplementary screening. This includes understanding their knowledge, beliefs, concerns, and preferences related to dense breasts and supplementary imaging. Conducting qualitative and quantitative studies can provide insights into the psychosocial, emotional, and informational aspects influencing women's decision-making processes.

Subtheme 6.2: Resources women access for information on dense breasts

Participants discussed the various resources women access to obtain information on dense breasts. These resources included

healthcare provider consultations, online sources, patient support groups, educational materials, and media coverage. Understanding the quality, accuracy, and comprehensibility of these resources is important to ensure women receive reliable and evidence-based information.

Subtheme 6.3: The importance of women being well-informed

Participants recognised the significance of women being well-informed to make informed decisions regarding supplementary screening. They emphasised the need for clear communication, patient education, and shared decision-making between healthcare providers and women. Ensuring that women have access to accurate and understandable information can empower them to actively participate in their healthcare decisions.

Subtheme 6.4: Positive experiences of women undergoing supplementary screening

Some participants reported positive experiences expressed by women undergoing supplementary screening. Women who received supplementary imaging felt reassured, empowered, and satisfied with their comprehensive screening approach. They appreciated the additional clinical information provided by the supplementary imaging modalities, which contributed to increased confidence in the screening process and improved peace of mind.

Subtheme 6.5: Negative experiences expressed by some women

However, some participants also mentioned negative experiences expressed by certain women undergoing supplementary screening. These negative experiences may stem from various

Table 7
Participants' quotes for theme 6.

Theme 6: Views of radiologists and radiographers on women's perception towards supplementary screening		Participants' Quotes
Subthemes:	More Research is Needed to Investigate Women's Perception and Needs	'Well, I believe that the screening programs are changing in future. I have this hunch that it's going to be more personalized. But it's very important that we wait for the studies to be ready, and then, after that, that we get a European-level statement or some kind of agreement how we are doing it.' (P4, Radiographer, Finland)
	Resources Women Access for Information on Dense Breasts	'But I think primary care needs to be involved because they trust their GPs. GPs is the first sort of medical—yes, it's the first medical window environment they go to.' (P10, Consultant Breast Radiologist, UK) 'It might be Google— but not much, but not much else, Google and, and, and their friends, uh, but not much else.' (P7, Consultant Breast Radiologist, Malta)
	The Importance of Women Being Well-Informed	'I think we have to find out how to communicate to them why we are taking the extra images because many of them have been in the program for years and they're coming every second year. And they may be scared if we take more pictures. So we have to communicate why before they come, we can communicate in our letters to them and maybe make some campaign that there's this new way to look at the breast. And it's not because we think there's anything, but it's because we want to make sure.' (P7, Consultant Breast Radiologist, Malta) 'No, but also the harms. It's always a balanced information. Never give only the benefits, because then you're doing harm to women. They have to decide upon themselves whether to accept or decline the invitation. And it is the goal of the government in order to send them just as much information as they need to take a well-balanced decision regarding the benefits and the harms. So we are not providing only the beneficial part of it, definitely not. It's always a balanced information because then you can make a good decision. And if you're only giving the beneficial effects of this, it's propaganda. And if you're not medical, you cannot make a well-balanced decision because afterwards, they can always say, "If I had known that mm—mm."' (P12, Breast Radiologist, Netherlands)
	Positive Experiences of Women Undergoing Supplementary Screening	'Women who have dense breasts are unaware that they have dense breasts so they don't know what exactly that means. So when it is proposed to them, because an in-depth analysis and therefore a particular study, they are very happy about it. They are told why and so they have a membership, we have a very high membership. Explaining to them that a breast is more at risk than a completely fatty breast gives them knowledge so they realize what that means. Because when the patients arrive they have absolutely no idea what it means. Because a dense breast is a breast rich in glands which, over the years, should disappear but instead remain and therefore this is even more dangerous.' (P5, Radiographer, Italy) 'I think ladies will be— the majority of them will be very keen if they understand the value of what we're offering, and then probably they will be— because we got such a good uptake, so it means our local population trusts— has a trust in the breast screening in. So I think they would be very keen, if they understand why we're doing it, and probably would be grateful that we offer them extra imaging.' (P10, Consultant Breast Radiologist, UK)
	Negative Experiences Expressed by Some Women	'lot of ladies do get really quite worried. They go, "Oh, why do I have dense breasts?" And I'm like, 'It's just how you're made up. And that's just you.'" And I say, "It does sometimes impact the imaging during the X-rays and things like that." So I think ladies are slightly quite apprehensive when they've got quite dense breasts unless they've been reassured and just told that it's normal.' (P1, Radiographer, UK) 'They are afraid, but— Yeah. It's why now a lot of us say it to the woman when we saw that it's going to happen, just because the stress doesn't bring anything.' (P13, Radiographer, Switzerland) 'Well, I can tell you that, again, 10 out of 10 women, when they hear that they have to do some, an additional examination. They will right away think, "Oh, my dear goodness. I have cancer." And for me, this is not good because you have a stressed woman that sometimes you need to do to perform an additional mammogram, and she's already stressed' (P11, Senior Radiographer, Greece)

factors, including increased anxiety, false-positive findings, additional testing, and biopsies, perceived overdiagnosis, and potential harms associated with unnecessary interventions. Addressing these concerns and providing appropriate support and counselling can help mitigate the negative experiences and improve women's overall satisfaction with supplementary screening.

Discussion

Upon comparing the findings of this study with earlier research, it becomes evident that utilizing additional imaging techniques following mammography is recognised and regarded as beneficial within the domain of dense breast analysis.²⁰ While mammography remains the primary screening method, its limitations in detecting cancers in dense breast tissue are acknowledged.³¹ The challenges associated with integrating supplementary screening, including issues with accessibility, resources, and differences in protocols, are consistent with previous research in the field^{32,33.}

Additionally, insights gathered from the interviews shed light on both the drawbacks and benefits associated with training initiatives, emphasising the necessity for more thorough and specialised training, especially regarding screening for dense breasts. These

findings are consistent with the concerns raised in previous research,^{34,35} which also emphasised the significance of ongoing professional development and specialised training to enhance the competence of healthcare practitioners.

Furthermore, the interviews conducted with professionals involved in breast cancer screening illuminate the challenges and prerequisites related to training for the implementation of supplementary screening. The findings underscored drawbacks such as limited resources and restricted access to training, alongside positive aspects such as access to accredited and cost-free training opportunities. The inadequacy of training specifically focused on dense breast screening and the requirement for more comprehensive training programs were also acknowledged. Integrating education on dense breasts into continuous professional development and emphasizing specialised training for specific imaging modalities can enhance the proficiency and capabilities of healthcare practitioners.^{36,37}

In this study it becomes apparent that the awareness and application of guidelines for imaging such women present a persistent challenge. Similar studies conducted in various regions have also underscored inconsistencies in adhering to guidelines and a lack of awareness among healthcare practitioners.^{38,39} These

findings highlight the significance of continuous education, collaboration, and knowledge sharing to establish uniform and evidence-based breast imaging protocols across Europe. The research findings reveal a varied level of awareness concerning the European Commission Guidelines on imaging such women within the European breast imaging community. While some participants demonstrated a comprehensive understanding of relevant literature and European Society guidelines, others were unaware of the introduced European Commission Guidelines.⁴⁰ Enhancing the dissemination of knowledge, fostering collaboration, and promoting ongoing education within the European breast imaging community are crucial steps to improve awareness and ensure effective implementation of the guidelines.⁴¹

Insights from the interviews with healthcare professionals have provided valuable perspectives on the obstacles and potential approaches for integrating supplementary screening for such women. The identified challenges encompass a spectrum of issues, including financial constraints, logistical complexities, difficulties specific to various screening methods, the necessity for further research, obstacles associated with patients, political barriers, staff-related hindrances, and time constraints. These challenges call for comprehensive and multifaceted solutions which emerged from the study findings, such as the integration of AI, convening consensus meetings, patient education initiatives, augmentation of human resources, enhancement of communication channels, specialised training provisions, personalised screening approaches, and increased investments in resources. These are essential in addressing these challenges and facilitating the successful integration of supplementary screening practices.^{42–47}

Moreover, the insights garnered from the interviews conducted with clinical radiologists and radiographers have illuminated the factors influencing the introduction of supplementary screening for such women, alongside the challenges linked with its implementation. Subthemes that emerged include the role of DBT as a predictive factor, the imperative for further research, the significance of adhering to guidelines, the necessity for appropriate human resources and specialisation, the requirement for general resources, and the mixed sentiments among professionals regarding the adoption of new practices.^{13,21,48,49}

Lastly, insights gleaned from interviews with breast cancer screening professionals have offered valuable perspectives on women's perceptions and needs concerning supplementary screening. This echoes the findings of the PROCAS study, suggesting that integrating breast density and DNA data into screening protocols can enhance the accuracy of risk assessment. Incorporating these insights into screening programs holds promise for improving effectiveness, though further research is needed to explore factors such as cost and the psychological impact of risk notification on women's well-being.⁵⁰ The emphasis on conducting additional research to understand women's attitudes and requirements, as highlighted in this study, aligns with previous recommendations to tailor breast cancer screening programs to meet women's specific needs.^{51,52} Additionally, the emphasis on ensuring that women are well-informed resonates with insights from various authors regarding the crucial role of patient education in enhancing the screening experience.^{53,54}

Limitations

The data collection period coincided with the reopening of screening units after COVID-19 closures. During this period, participants were exceptionally busy, which limited their availability to partake in the study. Despite the attempt to recruit participants from several countries, the participation rate was low.

Conclusion

The findings from a qualitative exploration of this area provided understanding of the key aspects related to supplementary imaging for such women and insight into some of the challenges associated with implementing supplementary screening. The six identified themes, namely Theme 1: Understanding and experiences of supplementary imaging for such women, Theme 2: Challenges and requirements related to training amongst clinical radiographers and radiologists, Theme 3: The awareness of guidelines on imaging women with dense breasts, Theme 4: Challenges to implement supplementary screening, Theme 5: Predictors of Implementing Supplementary screening, Theme 6: Views of radiologists and radiographers on women's perception towards supplementary screening, have enriched the understanding of the complex dynamics within this domain.

The interviews conducted as part of this study have revealed a rich tapestry of insights and perspectives, underscoring the multifaceted challenges and opportunities inherent in the domain of breast cancer screening for such women. The themes that emerged have each shed light on critical aspects that warrant attention and further investigation.

Conflict of interest statement

None.

Acknowledgements

We extend our sincere gratitude to Ms. Cheryl Cruwys, Dr. Athina Vourtsi, Dr. Gioele Santucci, the European Federation of Radiographer Societies (EFRS), the European Society of Breast Imaging (EUSOBI), and Dense-Breast Info Organization for their invaluable support and collaboration during this research study. Their expertise and assistance have been instrumental in advancing our study.

This work is part of a PhD programme which is part-financed by the Tertiary Education Scholarship Scheme (TESS), Government of Malta (TESS Contract MEDE 417/2018/61). The main author would like to thank the TESS for the financial support offered that covers the University of Salford fees. The funding source was not involved in the review.

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