ORIGINAL ARTICLE

The Radiographers' Perspective on the Perfect Good Moderate Inadequate (PGMI) Mammographic Image Evaluation Classification Approach: A Qualitative Study

Alice Demi Numpang[1,2], Mariaulpa Sahalan[1,3], Maheza Irna Mohamad Salim[1,3], Norhashimah Mohd Norsuddin[4]

[1] Department of Biomedical Engineering and Health Sciences, Faculty of Electrical Engineering, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia
[2] Institut Latihan Kementerian Kesihatan Malaysia Johor Bahru, 81200 Johor Bahru, Johor, Malaysia
[3] Diagnostic Advanced Diagnostic and Progressive Humancare Research Group, Department of Biomedical Engineering and Health Sciences, Faculty of Electrical Engineering, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia
[4] Diagnostic Imaging & Radiotherapy Program, Centre of Diagnostic, Therapeutic & Investigative Studies, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, 50300 Kuala Lumpur, Wilayah Persekutuan Kuala Lumpur, Malaysia

ABSTRACT

Introduction: Malaysia has used the Perfect, Good, Moderate, Inadequate (PGMI) classification to assess mammographic image quality since 2018. Reliability of this classification is crucial for assessing image quality. Therefore, this study aims to investigate radiographers' comprehension and perspectives regarding image criteria in the PGMI classification. **Materials and Methods:** Six female radiographers from six Malaysia's public hospitals with work experience from six to seventeen years (mean = 13.5 years, SD = 4.11 years), were recruited to participate in a focus group discussion (FGD). All nine image quality domains in the PGMI classification were discussed during the FGD. The data was analyzed using content analysis with ATLAS.ti 22. **Results:** The study found that the professional group whom assess the mammographic image quality was varied among hospitals. The study also found 'pectoral muscle visualized at chest wall' and 'nipple in midline of imaged breast' quality criteria were not relevant and clinically not easily achievable. Participants had diverse interpretations of the acceptable tolerance for visualizing the pectoral muscle shadow up to nipple level and assessing image symmetry. Distinguishing between the Perfect (P) and Inadequate (I) categories was straightforward. However, differentiating the Good (G), Moderate (M), and Inadequate (I) categories based on entire breast tissue visualization, exposure, compression, and symmetry criteria posed challenges. Furthermore, participants had difficulty in deciding whether to accept or reject images. **Conclusion:** The definition and description of the quality criteria in the PGMI classification were not standardized and difficult to comprehend thus may lead to inaccurate classification of mammographic image quality.
Malaysian Journal of Medicine and Health Sciences (2025) 21(6): 1-10. doi:10.47836/mjmhs.v21.i6.1412

Keywords: Mammography, image quality, image evaluation system, PGMI classification, focus group discussion

Corresponding Author:
Mariaulpa Sahalan, PhD
Email: mariaulpa@utm.my
Tel: +6016-723 3204

INTRODUCTION

Breast cancer remains one of the disease burdens around the world, including Malaysia. According to the GLOBOCAN 2022 report, breast cancer is the most common cancer type (31.3%) among Malaysian women (1). In 2019, the third edition of the Malaysian guidelines for Management of Breast Cancer acknowledges the significance of breast cancer detection and enhanced radiological imaging in combating breast cancer (2). Early detection of breast cancer through mammography screening relies on the high-quality mammograms produced. A mammogram is of high quality when the radiologist able to recognize subtle changes on the mammographic features of breast cancer that yield diagnostic information with the least possible radiation exposure to the patient (3).

In Western countries that have a population-based breast cancer screening program, the quality of the mammograms produced are governed and accredited by professional bodies such as the Royal Australian and New Zealand College of Radiologists (RANZCR), the

National Health Breast Screening Program (NHBSP), and BreastScreen Australia (BSA) (4). They had established a set of image evaluation criteria which is called the image evaluation system (IES) to assess the quality of mammograms (5). One of the most reported IES used in assessing image quality is the PGMI system where images ranked as perfect, good, moderate or inadequate (6).

Whilst the Malaysia government acknowledges the outcome of breast cancer and the need for enhanced imaging in our Management of Breast Cancer guideline in 2019, there is no government-funded breast cancer screening and efforts focus on opportunistic breast cancer screening program with the current available resources (7). The production of mammograms was not formally oversight and governance by the dedicated screening program, however the quality assurance was monitored by the Quality Assurance Program (QAP) in Radiology Services under the Atomic Energy Licensing Act of 1984 (Act 304) (8).

Radiographers in Malaysia have been using the PGMI classification since 2008 and the same guideline still in use although it has been revised in 2019 (8). This PGMI classification of image quality based on nine image assessment domains: (1) entire breast tissue imaged, (2) identification, (3) exposure, (4) compression, (5) movement, (6) processing, (7) artefacts, (8) skin fold, and (9) symmetrical images. Mammograms which are fall into P, G and M categories will be accepted and passed for further diagnosis, however mammograms with I category will need to repeat. According to the guideline, two professional groups which consist of one radiographer and one radiologist need to rate four views of mammograms and give a final score to the overall mammogram. The common goal of the two professions is the provision of images of high quality ensuring a precise diagnosis. Therefore, they ought to share the same standards for subjective perceived image quality (9).

Radiographers play a major role in the optimization of image quality because they position the patients, determine the technical adequacy of the exposure factors, compress the breast and assess the quality of the mammograms produced (3). Therefore, the clinical efficacy of mammography is largely depended on the radiographer's expertise (10). In clinical practice, radiographers face several challenges, including accommodating individual patient needs, adapting to technological advancement, and pursuing continuous professional development (11). Besides, the image quality assessment may be challenging for radiographers. In this regard, previous study showed that 52% (n=100) radiographers need for additional education in image quality evaluation (10). Radiographers assessing image quality need to comply with the guidelines established to ensure consistency and standardization in their clinical practice (12). Classify mammographic image quality using the PGMI classification is a time-consuming procedure, and often limited to a selective sample of mammograms (13). Furthermore, performing image quality assessment are subjective and differs between assessors, thus raising concerns about the validity and reliability of the classification (12,14). However, it is still a pre-requisite for radiographer to achieve high-quality images to achieve high sensitivity in screening mammography.

Subjective quality assessment task can lead to inconsistencies among assessors (15). A study in Malaysia showed that poor inter-rater agreement (overall kappa value of 0.10) and moderate intra-rater agreement (intraclass correlation coefficient (ICC) value of 0.63) were observed among 28 radiographers when using the PGMI classification when assessing image quality (16). Minimal research has been conducted recently that explores Malaysian radiographers' current practice and understanding on the PGMI image evaluation classification approach. Furthermore, no qualitative studies have been done regarding radiographers' understanding concerning the image evaluation criteria. Enhancements to the current evaluation system require an understanding of radiographers' insights, experiences, and expectations. This study aims to fill this gap by using a qualitative approach to explore radiographers' current practices, understanding, and application of the PGMI classification. The use of focus group discussion appropriate for collecting data on perceptions, opinions, beliefs, and understanding regarding the utilization of the PGMI classification in mammographic image quality assessment.

MATERIALS AND METHODS

Study Design

This study used an exploratory, descriptive qualitative approach. This study approach should be the methodology of choice when the aims of the research were to produce a straight forward description of the phenomena (17). This approach enables the researcher to identify who is involved, what occurs and where events took place in relation to the phenomena of interest (18).

Study Population

For this exploratory study, a purposive sampling strategy was implemented. Purposive sampling strategy represents one of the most scientifically appropriate approach for descriptive qualitative research that allow the researcher to describe the phenomena (18).

The target group of this study consisted of all six female radiographers from the 2022/2023 batch of the Advanced Diploma in Breast Imaging program at the Training Institution of the Ministry of Health. The inclusion criteria for participant selection were

radiographers trained in the PGMI module during their educational training and possessing experience in assessing mammographic image quality using the PGMI classification. These shared features of experience or culture may enable the researcher to better appreciate the participants' responses and the language they choose to express themselves. Due to several similar traits, such as gender, age group, and professional experience, the participants were able to leverage their familiarity with each other and relate to their shared working experiences (19). In this study, the researcher's insider knowledge facilitated understanding the important points within the correct context. This familiarity among participants resulted in a lively discussion that provided informative data beneficial to the research.

Data Collection

The overall process of the focus group discussion was shown in Figure 1. An open-ended adaptable conversational interview strategy was used as this is thought to yield more measured responses than closed questions, as well as establish participants' perspectives and experiences, thus fulfilling the study's objectives (20). Qualitative interviewing which is referred to the standard of qualitative research was deemed the most appropriate method to elicit the views of this small population of radiographers (18). This strategy aided the study by revealing the participants' experiences with the research issue as they saw it rather than as the researcher saw it, with the researcher only acting as a moderator. Topic guide as shown in Table I was produced to help the researcher activate dialogue. The topic guide is partitioned into three main sub-topics which including the overview and experience of participants when using the PGMI classification in assessing mammographic image quality in the real clinical setting, nine image assessment categories and their suggestion on how to improve the current classification.

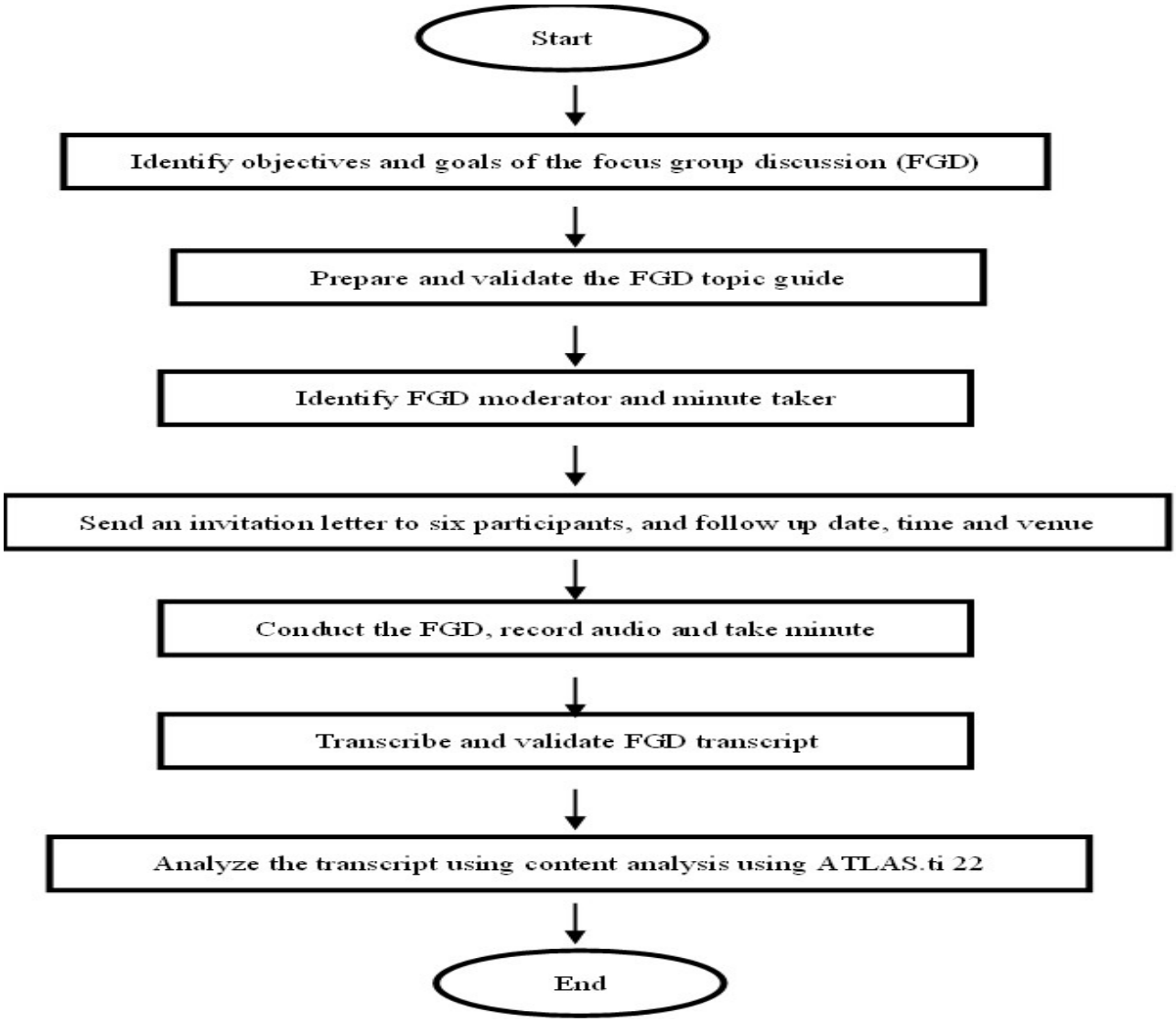

Figure 1 : Process of data collection and analysis of the focus group discussion

Table I : Discussion topic guide

A.	Pertaining to assessor general overview of PGMI classification method
1.	Could you tell us about your experiences using the PGMI classification when assessing mammographic image quality?
2.	What is your general view about this PGMI classification?
B.	Pertaining to nine image quality assessment in the PGMI classification
1.	Are you aware of the nine image quality assessments in the PGMI classification?
	a. All breast tissue imaged
	b. Correct image identification clearly shown
	c. Correct exposure
	d. Good compression
	e. Absence of movement
	f. Correct processing
	g. Absence of artefacts
	h. No skin folds
	i. Symmetrical images
2.	Are there any other image criteria that you use to assess mammograms other than the above mentioned-criteria?
3.	Is the image criterion relevant to you? Why or why not?
4.	How do you find the image criteria are helpful in classifying between categories?
5.	How do you find the image criteria are helpful in deciding accept/reject?
C.	Improvement/Suggestions
1.	How can we improve it?

Focus group discussion protocol

Three main individuals were involved in the focus group discussion: a researcher who acted as the facilitator, a note taker and an assistant responsible for audio recording. This discussion was conducted in a round-table meeting room at the training institution during working hours. Before the session, the facilitator explained the study's purpose and outlined the steps involved. The consent forms were distributed prior to the session. The discussion was audio recorded using mobile phone (Android) and laptop (HP, Windows 11, 64 bits) and note taker assisting in capturing key points. The entire discussion lasted 240 minutes, splits into two sessions (morning and afternoon). During the discussion, the facilitator used a logical sequence of open-ended questions to encourage in-depth dialogue and foster energy among participants. This approach led to a moderated discussion to ensure a fair contribution from all participants. The moderated discussion allowed underlying opinions, meanings and emotions to emerge alongside descriptions of individual experiences, enriching the data collected from each participant.

Data analysis

The recorded audio was transcribed using verbatim transcription to create a transcript. The transcript was then read three times and the audio was re-listened three times to ensure that no ideas were missed. An expert with 14-years of experience in the PGMI classification validated the authenticity of the transcripts (21).

ATLAS.ti 22 facilitates this process by offering tools for organizing codes, visualizing data, and conducting analysis which enhances the efficiency and depth of the analysis. The analysis begins with reading the transcript and familiarizing with the data patterns to get an overview of the study. Then, the first-round coding was initiated by identifying big-picture meaning units, which could be a word, a couple of words, or a sentence. During the second-round coding, the units were refined into subcategories, which then developed into main categories, eventually leading to the final connecting themes. The researcher and an expert reviewed and validated the themes prior to defining and naming them. Once the themes were finalized, a subsequent report was generated.

Ethical consideration

Ethical approval was obtained from the Faculty of Medicine and Research Ethics Committee, The National University of Malaysia (Approval number: UKM/PPI/111/8/JEP-2023-375). Informed consent was obtained from all subjects involved in the study.

RESULTS

Demographic of Participants

This study sample included six female participants, aged between 30 and 44 years. All participants had accomplished Advance Diploma in Breast Imaging in Training Institution of Ministry of Health in Johor Bahru, Malaysia. Four of them worked in central hospitals while the remaining two in district hospitals. All of the participants had prior experience in mammographic image evaluation using the PGMI classification approach.

Themes and Subthemes

The data analysis generated three major themes reflecting the participants experiences, perceptions and understanding on the PGMI classification approach. These are (1) experiences when utilizing the PGMI classification in assessing mammographic image quality, (2) understanding on the image evaluation criteria in the PGMI classification and (3) improvement of the current image evaluation classification used.

Theme 1: Experiences in utilization of the PGMI classification

The first key point during the focus group sessions was their experiences using PGMI classification approach in assessing mammographic image quality. All participants are aware of the PGMI classification and all are utilizing the same approach when assessing mammographic image quality in their respective clinical settings. However, who is responsible for classification became a subject raised in this discussion. According to the national guideline, one radiographer and one radiologist will assess and give the classification to the mammograms produced. In the case of disagreement, both professional groups need to discuss together and came into a final classification. But this is not the case for the medical facility with no resident radiologist in-site. This can be seen from the statements of participants stated below:

In my department, the radiographer who did the mammogram will do the first classification, and the radiographer in-charge will do the second classification, and the final classification will be the consensus among us… because there is no radiologist in my district hospital, so we do among us. (P1)

Radiographer who performs the examination will do the classification, and radiologist will do later according to her own time, without the discussion among radiographer and radiologist…the final classification will be done by the mammographer-in-charge. (P2)

All classification will be done by the mammographer-in-charge. (P3)

Radiographer who performs the mammogram will discuss with the senior radiographer and do the first classification, then the radiologist will discuss with the senior radiographer to decide the final classification. (P5)

The opponents stated that using one professional group (radiographer) without the opinion of other professional group (radiologist) is not fair because two different professional groups will have different opinion. The rating cannot solely rely on the radiographer, as they feel the need for the radiologist to confirm whether the image can be accepted or rejected.

In my opinion, when only radiographers providing the rating, this increases the chances of high rating (P and G class) because radiographers will tend to give high score and tend to pass the images for reporting…if there is radiologist, their expectation is usually higher than the radiographer. (P4)

Theme 2: Understanding on the image evaluation criteria in the PGMI classification

The second key point during the discussion was pertaining to the image criteria listed in the PGMI classification approach. All of the participants are aware of the nine categories of image assessment and their respective image criteria. However, they did not use all of the listed image evaluation criteria when assessing image quality due to their different experiences in the real clinical setting. Among one of the evaluation criteria that they did not used for evaluation was "pectoral muscle visualized at chest wall" because this presentation was rarely seen on the real clinical images. This can be seen from the statements of participants stated below:

I rarely seen pectoral muscle visualized at chest wall in CC view…through my experience I would say maybe it was seen in one out of ten patients. So, I didn't use this criterion when assessing CC view as it is not achievable in most of the cases. (P1)

Pectoral muscle is difficult to be seen on chest wall… depend on patient body…maybe out of ten patients, can be seen in one patient. (P2)

Sometimes can see, sometimes cannot see…depend on the ability to pull the breast…if the breast can be easily pulled, then the pectoral muscle can be seen, if difficult to pull, then hard to be seen. (P4)

Another image evaluation criteria that two participants did not used for evaluation was "nipple in midline of imaged breast" for the evaluation of the craniocaudal (CC) view. They stated:

The nipple is not necessarily in the midline of the breast…if midline separate equally, usually the lateral breast tissue will be cut-off. (P1)

I also not prefer this criterion. For me, as long as the nipple was in profile, it would be enough…the nipple is not necessarily in the midline. (P4)

Subsequently the way the description used in describing the image criteria was discussed. Majority of the participants highlighted that descriptors are subjective and difficult to know what the criteria want to fulfill exactly. Majority of the participants were confused about "pectoral muscle shadow to nipple level" criteria in mediolateral oblique view, as quoted below:

The word shadow is a bit confusing, is it the tip of the pectoral muscle? (P5)

I don't know what is the pectoral muscle shadow. As long as I can see the pectoral muscle, I assume it is seen (P3)

I don't know where is the shadow of the pectoral muscle? Is it the tip of the whole pectoral muscle must be presenting toward the nipple? (P2)

The participant highlighted that certain image criteria

such as "patient ID", "presence of movement", "artifacts" and "skin folds" were easy to classify between categories. However, they found ascertain to discriminate between correct versus incorrect exposure and processing, good versus not good compression.

I am not really concern about exposure and processing as long as the automatic exposure chamber (AEC) working well, then I assume everything is correct…Unless I work in film-screen mammography, then I would be more cautious about exposure and processing. (P2)

For the good compression, usually I would compare the compressed breast thickness between RCC and LCC, and if there are no 30% differences, I would say the compression is good. (P2)

During the focus group meetings, the participants indicated that they have different tolerance limit on "the posterior nipple line on the mediolateral oblique (MLO) should be no more than 1 cm on the CC view" image evaluation criteria when deciding to downgrade image from P to G category.

When I measure posterior nipple line (PNL) on CC and MLO views, I would accept the range difference between 1.0 to 1.2 cm as P category and if it is >than 1.2 cm, I will downgrade to G. (P1)

It supposed to be 1 cm, but usually I still accept if it is <1.2 cm difference. (P3)

Furthermore, all of the participants showed level of agreement regarding their likelihood to accept (P, G and M category) or reject (I category) the image for "symmetrical images" criteria, as quoted below:

I measure it from the nipple to the back of the image on CC view and only accept within 1.0 difference when deciding right craniocaudal (RCC) and left craniocaudal (LCC) are symmetrical. (P1)

For asymmetrical evaluation, if there is more than 1.2 cm difference between both views, I would reject the image. (P5)

Theme 3: Improvement of current mammographic image quality assessment approach

This theme reveals the opinions of participants on what they expect to improve in the current image evaluation approach. There were two categories of improvement emerges as follows:

(a) Automated assessment of the PGMI classification approach

This improvement was pertaining to the automated image assessment instead of manual classification. Three of the participants did mention it during the discussion which including the following improvement quoted by the participants:

Doing PGMI classification is really time-consuming… if the vendor can think of automated rating assessment system built-in the mammography working station, it would be easier for us. (P1)

Vendor can automatically set the PGMI classification in the system, something like the reject-analysis software. (P2)

Create a software that can assess the classification of image quality in the system, easy to retrieve, store and can replace the paper-based record. (P3)

(b) Image evaluation criteria in PGMI

This improvement was pertaining to the image evaluation criteria that lead to misinterpretation and misunderstanding of the participants. The following improvement quoted by participants:

Improve on the ways to describe the quality criteria (P1)

Instead of written as 'full width of pectoral muscle seen', it should be described in full sentence what it means by 'full' width…maybe can define as width of the pectoral muscle presented on the top of the image is the same as the width of the breast tissue presented on the top of the image. (P2)

Certain image criteria can be excluded…depending on the achievability in the clinical setting. (P3)

It would be better to describe symmetrical images between P, G, M and I categories, include the diagram as well. (P4)

I think some image criteria can be re-define, and some can be complemented with diagram, for example showing anatomical landmark for posterior nipple line (PNL) and nipple level (NL). (P5)

If the image criteria are relevant to be assessed, it should be written in words. For example, 'The posterior nipple line (PNL) on the CC should be no more than 1cm than on the MLO view' criteria were appeared in the diagram but not written. (P6)

DISCUSSION

This section discusses the crucial role of radiographers in assessing mammographic image quality, focusing on their expertise and influence on PGMI classification accuracy. This section also discusses the definition and description of image quality criteria, explores the decision-making process in PGMI classification, and examines the potential of automated image assessment advancement in enhancing the overall evaluation process.

Theme 1: Experiences in utilization of the PGMI classification

Role of radiographers in utilization of the PGMI classification in image quality assessment

Regarding responsibility for utilizing the PGMI classification to assess the mammographic image quality, participants suggested that the national guideline specify eligible and qualified personnel to perform this task in the absence of radiologists. Despite most participants' willingness to include two different professional groups as raters, there is no consensus about who should be responsible to be the second assessors when the radiologist is unavailable.

The use of different professional groups as assessors may impact the outcome of the mammograms image quality assessment. Evidence from a multi-center international evaluation assessing the screening mammograms, supported by a study using radiologists and radiographers, found that radiographers prioritize the aesthetic aspect, while radiologists focus on whether the relevant information is present in the mammogram (22). Another study found a similar pattern when assessing the consensus among radiographers and radiologists on breast implant image criteria. It discovered that both professional groups view mammograms differently, with radiographers focusing on specific anatomical details, while radiologists emphasizing on overall assessment (23). A study on the clinical acceptability of chest, hip, and cervical spine radiographs revealed significant differences in categorization, with radiographers being stricter in their evaluation. This often led to higher rejection rates and unnecessary repeat imaging (20). However, the proposed strategies to assess image quality were still considered subjective, and the need for standardization was highlighted.

Theme 2: Understanding on the image evaluation criteria in the PGMI classification

(a) Understanding of definition and description of image quality criteria in the PGMI classification

The second theme focused on the definition of image quality criteria. subjective descriptors such as 'pectoral muscle shadow to nipple level,' 'correct exposure,' and 'good compression' pose significant challenges for radiographers, creating decision-making dilemmas. This finding was similar with the study analyzed the evaluation criteria using pectoral muscle presentation, which pointed out that the descriptor used to determine the inclusion of all breast tissue on the MLO view are not well defined and lead to subjective interpretation of the assessors (24–28). The terms like 'correct' and 'good' are being used to describe the adequacy of the image criteria, but they are open to individual interpretation that leads to variations in their final image quality assessment.

In a review of methods of clinical image quality evaluation in mammography found a variation in the categories of criteria used, number of criteria, the descriptors of the criteria and the instructions used to assess the criteria. It was suggested that a clearer description of image criteria rather than more criteria which may result in more accurate classification (23,29). Defining image criteria more precisely could reduce assessors' reliance on individual interpretations, highlighting the need for standardization of subjective criteria.

(b) Role of subjectivity and decision-making on PGMI classification

Another finding was participants have different prioritization when deciding to accept or reject image. For example, majority of the participants were strictly downgrading image to I category (reject) for "symmetrical images" criteria. If there were asymmetrical between right and left for both craniocaudal (CC) and mediolateral oblique (MLO) views >1cm, they tend to reject the image. In contrast, they have discrepancy tolerance limits when assessing "posterior nipple line (PNL) on the CC view should be within 1cm of PNL on the MLO view" criteria. Two participants accepted only a 1cm difference, two participants tolerated discrepancies of 1.0 to 1.5 cm, and another two did not accept differences exceeding 1.2 cm.

This finding has considered various potential influences on the decision-making process by radiographers when deciding to accept image. Previous studies have considered various potential influences on the likelihood to reject images during quality assessment (30–32). A study assessing 74 radiographers from three different countries reported that inappropriate detector exposure was statistically significant correlated with radiographers rejecting chest, hip and cervical spine x-rays (30). Inappropriate positioning and suboptimal centering were the main reasons to reject X-ray images among radiographers (31). In contrast, a study on four radiographers found that they are rarely decide to repeat mobile chest images. However, they tend to reject on a technical basis even when the information provided is enough for radiologists to carry out a proper diagnostic evaluation (32). In this study, the decision-making of radiographers was significantly influenced by their own experience and training. Additionally, adherence to guidelines and protocols, along with collaboration with radiologists, played crucial roles in their acceptance or rejection of mammograms.

Theme 3: Improvement of mammographic image quality assessment approach

Potential of automated image assessment advancement

Participants extensively discussed enhancing current image quality assessments, with most suggesting the implementation of automated assessments. Recent years, an artificial intelligence (AI) automated system

has been developed aims at reducing subjectivity and time spent for quality assessment task. It also reducing the recalls rate because immediate quality assessment can be done before the patient leaving the screening center (13). Despite these benefits that AI brought, it still requires human as an observer to decide image quality criteria to be used and the determination of threshold to categorize between P, G, M and I categories. Human observer still needed to verify the result of the quality assessment.

Strengths and Limitations

To date, the findings of this study were among the first in Malaysia to gain insights into radiographers' views on their understanding and experiences using the PGMI classification to assess mammographic image quality. The current study benefit from rich data from focus group discussion and in-depth exploration. The spectrum of participants from different setting of hospitals and document analysis from the national guideline of the PGMI classification provided a data source triangulation that enhances the understanding of radiographers. The current study has some shortcomings. Firstly, the study involved only one focus group discussion with PGMI-trained radiographers, rather than multiple groups. Secondly, it did not consider the opinions and views of radiologists on the matter. Lastly, the study's limitation lies in its small sample size, which may hinder the generalizability of the findings. Despite these limitations, the study provides valuable insights into the challenges radiographers encounter in their daily clinical practice.

Recommendations for practice, policy and research

Notably, there are encouraging signs that the government's current efforts are on the right path, particularly in raising awareness about the image quality classification for assessing mammographic images. However, future efforts should focus on creating an evaluation framework that focus on developing clear, standardized criteria for image quality assessment, providing training for radiologists and technicians, conducting pilot tests, ensuring compatibility with existing systems, and implementing regular audits. Key priorities include accuracy, user-friendliness, comprehensive coverage, and a feedback mechanism. Policy implications include the establishment of national standards, mandatory quality assurance checks, resource allocation for training and equipment, and public awareness campaigns to emphasize the importance of image quality in mammography.

CONCLUSION

The description on image evaluation criteria stated in the national guideline of the PGMI classification were not standardized causing difficulty among radiographers to comprehend thus may lead to inaccurate classification of mammographic image quality. The study revealed that the tolerance limits for accepting images varied across six different hospitals. Radiographers could reduce the number of rejected images if they had a clearer understanding of the acceptable thresholds for diagnostic evaluation. Achieving this requires a thorough study involving interprofessional collaboration between radiographers and radiologists. This will help ensure accurate image evaluation criteria and prevent misinformation that could result in incorrect quality assessments. The study recommends establishing a framework to assess, evaluate, and harmonize the descriptions of image evaluation criteria.

Acknowledgements

This work was supported by Universiti Teknologi Malaysia Encouragement Research Grant Scheme (UTMER) Q.J130000.3851.19J27 from Universiti Teknologi Malaysia, Malaysia.

REFERENCE

1. Ferlay J, Ervik M, Lam F. GLOBOCAN 2022 [Internet]. 2024 [cited 2024 Aug 11]. Available from: https://gco.iarc.who.int/today. doi: 10.1002/jmrs.487
2. Academy of Medicine Malaysia. Management of Breast Cancer (Third Edition) [Internet]. 3rd ed. Malaysian Health Technology Assessment Section (MaHTAS); 2019. Available from: http://www.moh.gov.myhttp://www.acadmed.org.my. doi: 10.1002/jmrs.487
3. Galli V, Pini M, De Metrio D, de Bianchi PS, Bucchi L. An image quality review programme in a population-based mammography screening service. J Med Radiat Sci. 2021 Sep 1;68(3):253–9. doi: 10.1002/jmrs.487
4. Pape R, Spuur KM, Wilkinson JM, Zuhukepe A. A review of mammographic image quality in Papua New Guinea. J Med Radiat Sci. 2022 Mar 1;69(1):24–9. doi: 10.1259/bjr.20170611
5. Sweeney RJI, Lewis SJ, Hogg P, McEntee MF. A review of mammographic positioning image quality criteria for the craniocaudal projection. British Journal of Radiology. 2018;91(1082). doi: 10.1002/jmrs.538
6. Hofvind S, Vee B, Sɯrum R, Hauge M, Ertzaas AKO. Quality assurance of mammograms in the Norwegian Breast Cancer Screening Program. European Journal of Radiography. 2009 Mar;1(1):22–9. doi: 10.1259/bjr.20160770
7. Said ZM, Sutan R, Malaysia K, Yaakob J, Bandar L, Razak T. Are We Doing Enough in Promoting Breast Cancer Screening: An Evaluation of Malaysia Breast Cancer Screening Program. Malaysian Journal of Public Health Medicine. 2021;21(3):230–9. doi: 10.37268/mjphm/voi.21/no.3/art.1430
8. Ministry of Health Malaysia - 2019 - Implementation Manual of the Quality Assurance Program (QAP)

in Radiology Services under the Atomic. doi: 10.37268/mjphm/vol.21/no.3/art.1430
9. Ween B, Kristoffersen DT, Hamilton GA, Olsen DR. Image quality preferences among radiographers and radiologists. A conjoint analysis. Radiography. 2005 Aug;11(3):191–7. doi: 10.1016/j.radi.2005.03.002
10. Albeshan S, Alashban Y, Shubayr N, Alkhudairy A, Eliraqi F. An Evaluation of Radiographers' Experience in Mammography: An Explanatory Study. Iranian Journal of Radiology. 2022 Apr 1;19(2). doi: 10.5812/iranjradiol-121918
11. Metsälä E, Richli Meystre N, Pires Jorge J, Henner A, Kukkes T, Sá dos Reis C. European radiographers' challenges from mammography education and clinical practice – an integrative review. Insights Imaging. 2017 Jun 1;8(3):329–43. doi:10.1007/s13244-016-0542-1
12. Hill C, Robinson L. Mammography image assessment; validity and reliability of current scheme. Radiography. 2015 Nov 1;21(4):304–7. doi: 10.1016/j.radi.2015.07.005
13. Waade GG, Danielsen AS, Holen ES, Larsen M, Hanestad B, Hopland NM, et al. Assessment of breast positioning criteria in mammographic screening: Agreement between artificial intelligence software and radiographers. J Med Screen. 2021. doi: 10.1177/0969141321998718
14. Moreira C, Svoboda K, Poulos A, Taylor R, Page A, Rickard M, et al. Comparison of the validity and reliability of two image classification systems for the assessment of mammogram quality [Internet]. 2005. Available from: www.jmedscreen.com. doi: 10.1258/0969141053279149
15. Whaley JS, Pressman BD, Wilson JR, Bravo L, Sehnert WJ, Foos DH. Investigation of the variability in the assessment of digital chest x-ray image quality. J Digit Imaging. 2013;26(2):217–26. doi: 10.1007/s10278-012-9515-1
16. Mohd NN, Toh Z, Isa IC, Mohd ZN. Variability in mammographic images quality evaluation and Predictive factors affecting it. In: Journal of Medical Imaging and Radiation Sciences. Elsevier BV; 2022. p. S39–40. doi: 10/1016/j.jmir.2022.10.129
17. Hunter DJ, Mccallum J, Howes D. Defining Exploratory-Descriptive Qualitative (EDQ) research and considering its application to healthcare [Internet]. Vol. 4, Journal of Nursing and Health Care. 2019. Available from: http://eprints.gla.ac.uk/180272/http://eprints.gla.ac.uk. doi: 10.1002/jmrs.487
18. Sandelowski M. Focus on research methods: Whatever happened to qualitative description? Res Nurs Health. 2000;23(4):334–40. doi: 10.4236/oalib.1111001
19. Mack Natasha, Woodsong Cynthia. Qualitative research methods: a data collector's field guide. FLI USAID; 2005. 120 p. doi: 10.939704-98-6
20. Howard ML. An exploratory study of radiographer's perceptions of radiographer commenting on musculo-skeletal trauma images in rural community-based hospitals. Radiography. 2013 May;19(2):137–41. doi: 10.1016/j.radi.2012.12.002
21. Kleinheksel AJ, Rockich-Winston N, Tawfik H, Wyatt TR. Demystifying Content Analysis. 127-137. 2020;84(1). doi: 10.11157/fohpe.v23i1.544
22. Taylor K, Parashar D, Bouverat G, Poulos A, Gullien R, Stewart E, et al. Mammographic image quality in relation to positioning of the breast: A multicentre international evaluation of the assessment systems currently used, to provide an evidence base for establishing a standardised method of assessment. Radiography. 2017 Nov 1;23(4):343–9. doi: 10.1016/j.radi.2017.03.004
23. Sá dos Reis C, Gremion I, Richli Meystre N. Consensus about image quality assessment criteria of breast implants mammography using Delphi method with radiographers and radiologists. Insights Imaging. 2020 Dec 1;11(1). doi: 10.1186/s13244-020-00860-z
24. Spuur K, Poulos A. Evaluation of the pectoral muscle in mammography images: The Australian experience. European Journal of Radiography. 2009 Mar;1(1):12–21. doi: 10.1016/j.ejradi.2008.11.003
25. Bentley K, Poulos A, Rickard M. Mammography image quality: Analysis of evaluation criteria using pectoral muscle presentation. Radiography. 2008;14(3). doi: 10.1016/j.radi.2007.02.002
26. Spuur K, Poulos A, Currie G, Rickard M. Mammography: Correlation of pectoral muscle width and the length in the mediolateral oblique view of the breast. Radiography. 2010 Nov;16(4):286–91. doi: 10.1016/j.radi.2010.05.008

27. Strohbach J, Wilkinson JM, Spuur KM. Full-field digital mammography: the '30% rule' and influences on visualisation of the pectoralis major muscle on the craniocaudal view of the breast. J Med Radiat Sci. 2020 Sep 1;67(3):177–84. doi: 10.1002/jmrs.404
28. Naylor SM, York J. An evaluation of the use of pectoral muscle to nipple level as a component to assess the quality of the medio-lateral oblique mammogram. Vol. 5, Radiography. 1999. doi: 10.1016/S1078-8174(99)90038-X
29. Li Y, Poulos A, McLean D, Rickard M. A review of methods of clinical image quality evaluation in mammography. Eur J Radiol. 2010 Jun;74(3). doi: 10.1016/j.ejrad.2009.04.069
30. Decoster R, Toomey R, Smits D, Haygood TM, Ryan ML. Understanding reasons for image rejection by radiologists and radiographers. J Med Radiat Sci. 2023 Jun 1;70(2):127–36. doi: 10.1002/jmrs.641
31. Kjelle E, Chilanga C. The assessment of image quality and diagnostic value in X-ray images: a survey on radiographers' reasons for rejecting images. Insights Imaging. 2022 Dec 1;13(1). doi: 0.1186/s13244-022-01169-9
32. Saade C, Siblini L, Karout L, Khalife S, Hilal H, Abbas S, et al. To repeat or not to repeat: Radiologists demonstrated more decisiveness than their fellow radiographers in reducing the repeat rate during mobile chest radiography. Radiography. 2021 May 1;27(2):304–9. doi: 10.1016/j.radi.2020.09.003