




# BMJ Open Interventions to increase mammography screening uptake among women living in low-income and middle-income countries: a systematic review

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## ABSTRACT

**Objective** To systematically identify interventions that increase the use of mammography screening in women living in low-income and middle-income countries (LMICs).

**Design** Systematic review.

**Data sources** MEDLINE, Embase, Global Health, CINAHL, PsycINFO, Web of Science, Cochrane Central Register of Controlled Trials, Google Scholar and African regional databases.

**Eligibility criteria** Studies conducted in LMICs, published between 1 January 1990 and 30 June 2021, in the English language. Studies whose population included asymptomatic women eligible for mammography screening. Studies with a reported outcome of using mammography by either self-report or medical records. No restrictions were set on the study design.

**Data extraction and synthesis** Screening, data extraction and risk-of-bias assessment were conducted by two independent reviewers. A narrative synthesis of the included studies was conducted.

**Results** Five studies met the inclusion criteria consisting of two randomised controlled trials, one quasi-experiment and two cross-sectional studies. All included studies employed client-oriented intervention strategies including one-on-one education, group education, mass and small media, reducing client out-of-pocket costs, reducing structural barriers, client reminders and engagement of community health workers (CHWs). Most studies used multicomponent interventions, resulting in increases in the rate of use of mammography than those that employed a single strategy.

**Conclusion** Mass and small media, group education, reduction of economic and structural barriers, client reminders and engagement of CHWs can increase use of mammography among women in LMICs. Promoting the adoption of these interventions should be considered, especially the multicomponent interventions, which were significantly effective relative to a single strategy in increasing use of mammography.

**PROSPERO registration number** CRD42021269556.

## INTRODUCTION

Globally, female breast cancer is the most commonly diagnosed cancer, with an estimated 2.3 million new cases (11.7%) in 2020.

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The first systematic review to identify interventions that increase mammography uptake among women living in low-income and middle-income countries.
- ⇒ A thorough literature search of relevant electronic databases and reporting using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.
- ⇒ Non-English electronic databases were not searched.

It is responsible for 6.9% of cancer-related deaths, death rates being higher in low-income and middle-income countries (LMICs) than in high-income countries (HICs).<sup>1</sup> Substantial evidence showed that the stage at diagnosis is an important determinant of survival rate with low survival observed among women diagnosed at advanced stage.<sup>2</sup>

Mammography is considered the most effective screening method for early detection of breast cancers in asymptomatic individuals,<sup>3</sup> with a 15%–56% significant decrease in the risk of breast cancer mortality.<sup>4</sup> Notwithstanding, its use in LMICs is relatively low in comparison to breast self-examination (BSE) and clinical breast examination (CBE).<sup>2–5</sup> Various intervention strategies to increase mammography screening are available and categorised into client-oriented interventions, provider-oriented interventions and informed decision making following the Community Preventive Services Task Force (CPSTF) guide, a private, non-federal panel of public health and prevention specialists in the USA,<sup>6–8</sup> established to provide evidence-based findings and recommendations about community preventive services, programmes, and other interventions aimed at improving the health of the populace. The CPSTF guide strongly recommends interventions that

engage health workers<sup>9</sup> and multicomponent interventions<sup>10</sup> to increase breast cancer screening.

Although systematic reviews on the effect of different interventions to increase uptake of mammography screening have been published,<sup>6 11–17</sup> we found none focused on women living in LMICs. Therefore, this study aimed to identify the interventions that increase mammography screening uptake in women living in LMICs.

## METHOD

The published study protocol for this study can be assessed online (<http://dx.doi.org/10.1136/bmjopen-2021-056901>).<sup>18</sup> The study design followed the Preferred Reporting Items for Systematic Review and Meta-Analysis 2009 guidelines<sup>19</sup> and was prospectively registered with International Prospective Register of Systematic Reviews, with registration number CRD42021269556.

### Eligibility criteria

The inclusion and exclusion criteria were guided by the population, interventions, comparisons or control, outcome, time frame and study design framework.

Studies conducted in LMICs published between 1 January 1990 and 30 June 2021, whose population included asymptomatic women eligible for mammography screening, were included. Studies on client-oriented interventions (eg, client reminders, group education, one-on-one education, small media, mass media and client incentives) and provider-oriented interventions (eg, provider reminder and recall systems, provider assessment and feedback, and provider incentives) were included. Studies with or without a comparator group were included, with the comparator group being women who received no active intervention or usual care (routine standard screening services such as BSE or CBE). We included studies with a reported outcome of use of mammography by either self-report or medical records and employed quantitative, qualitative or mixed study design.

Studies involving women with a prior diagnosis of breast cancer or women who have had a mastectomy were excluded. In addition, studies not published in the English language were excluded as the review team does not have language translation support.

### Information sources/search strategy

Published, unpublished and grey literature in the English language were searched. CEO and IJN developed a search strategy using the Medical Subject Heading and free-text terms (online supplemental file). Using this, searches of MEDLINE, Embase, Global Health, CINAHL, PsycINFO, Web of Science, Cochrane Central Register of Controlled Trials (CENTRAL) and Google Scholar for articles published from 1 January 1990 to 30 June 2021 were performed on 12 September 2021. African regional databases, including African Index Medicus, African

Journal online and African Organisation for Research and Training in Cancer, Open Grey, and ProQuest Dissertations and Theses Global databases were searched for more published, unpublished and grey literature. An auto-alert system was created for Medline, Embase, PsycINFO, and Web of Science to notify the review team of newly published studies that may be useful. We created searches for CINAHL, CENTRAL, Google scholar, Cochrane and the other databases in January 2022, because we did not create autoalert systems for these databases. An additional search was performed of the bibliographies of relevant studies identified from the computerised search on 21 April 2022 just before data synthesis. The autoalert system was stopped 2 months after the data extraction (April 2022).

### Selection process

The saved searched studies identified by electronic database searches were imported into Covidence software. After deduplication, IJN and ILE independently screened the titles and abstracts of the studies with disagreements resolved by consensus or a third author (OIE). Full text of articles was retrieved, IJN and ILE independently assessed the studies for eligibility for inclusion in the review. Disagreements were resolved by discussion or a third author, OIE. The reasons for the exclusion of those studies screened in the full text were documented.

### Data extraction

IJN and ILE performed data extraction using a predefined data extraction table. Differences between reviewers were resolved by discussion and mutual agreement. Relevant participant, intervention, control and outcome data such as study year, location, study design, population, age group, screening status of participants, type of intervention, length of follow-up and source of reported outcome were extracted (table 1). Interventions were classified as client-oriented or provider-oriented. The primary outcome was defined as the proportion of women who had a mammogram screening.

### Risk of bias (ROB) within studies assessment

Using the Cochrane ROB tool<sup>20</sup> for randomised controlled trials (RCTs) and the Effective Public Health Practice Project (EPHPP) tool<sup>21</sup> for quasi-experimental study and cross-sectional studies, IJN and ILE independently assessed study quality.

### Patient and public involvement

There was no patient or public involvement in the design or execution of this study.

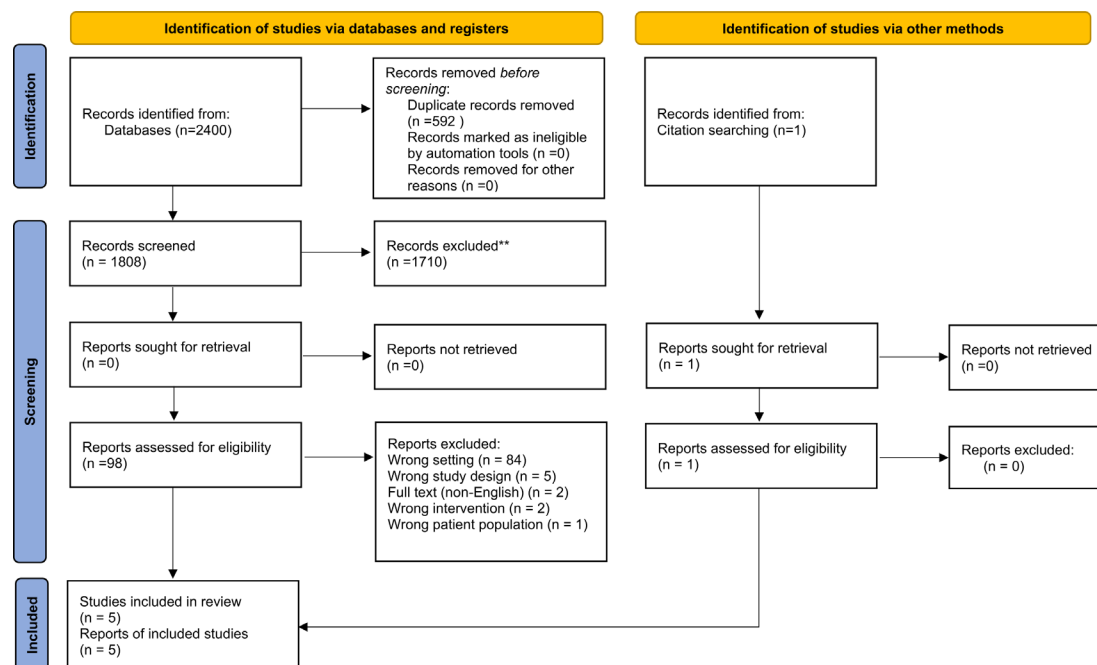
### Data analysis

A narrative synthesis of data from included studies was conducted.

**Table 1** Description of studies included in the review

Reference/location	Study design	Source of participants	Screening status of participants	Type of intervention	Description of intervention	Control group	Period of intervention
Lakkis <i>et al.</i> , <sup>23</sup> Lebanon	RCT	Family medicine centre	No mammogram in the last 2 years	Client-oriented	Three identical SMS text invitation to do a mammogram, spaced over a period of 4 weeks	SMS text invitation with additional informative text about the benefits of mammogram screening	April 2010–June 2010
Taymoori <i>et al.</i> , <sup>22</sup> Iran	RCT	Healthcare centres	Had received mammogram in the past 2–3 years No intention to obtain a mammogram within the next year	Client-oriented	Tailored educational intervention based on the HBM including constructs from the theory of planned behaviour, educational intervention based on HBM only	No education but received pamphlets after completing the follow-up questionnaire	Not stated
Ma <i>et al.</i> , <sup>24</sup> China	Quasi-experimental study	Workplace	No mammogram within the past 12 months	Client-oriented	Motivational group breast cancer education, dynamic group interaction and role play discussion sessions, printed educational handouts and delayed mammography navigation assistance	General healthcare education focusing on healthy lifestyle, printed materials, and delayed breast cancer education and mammography navigation after months of assessment	Not stated
Adib <i>et al.</i> , <sup>25</sup> Lebanon	Cross-sectional	Community-based	Not stated	Client-oriented	Pamphlets; street signs; bill boards; pink ribbons; radio and TV adverts; TV talk shows; SMS-text adverts; campaign banners on the homepages of major internet service providers; educational compact disc for presentations in community centres and social clubs; discount price of about US\$27 or less during the campaign month for mammography in participating centres	NA	October 2002–2005
Mauad <i>et al.</i> , <sup>26</sup> Brazil	Cross-sectional	Community-based	Not stated	Client-oriented	Broadcasts by radio and loud speakers, distribution of fliers, pamphlets and advertising posters to local public health facilities, general practitioner notification and home visits by community healthcare agents, and mobile mammography centres	NA	2003–
<b>Reference</b>	<b>Participants (n)</b>	<b>Age (years)</b>	<b>Location</b>	<b>Level of randomisation</b>	<b>Length of follow-up (months)</b>	<b>Source of outcome</b>	
Lakkis <i>et al.</i> <sup>23</sup>	385	40–75	Urban	Individual	6	Medical record	
Taymoori <i>et al.</i> <sup>22</sup>	184	50 and above	Urban	Individual	6	Medical record and self-report	
Ma <i>et al.</i> <sup>24</sup>	453	40 and above	Urban	Work site	6	Self-reported through phone interviews	
Adib <i>et al.</i> <sup>25</sup>	4800	35 and above	Mixed*	NA	NA	Self-report through a questionnaire	
Mauad <i>et al.</i> <sup>26</sup>	7192	20 and above	Rural	NA	NA	Medical record	

\*Mixed implies urban, rural and suburbs.  
HBM, health belief model; NA, not applicable; RCT, randomised controlled trial.



**Figure 1** Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram for identification of published studies for inclusion in review.

## RESULTS

The search identified 1809 studies. Following the title and abstract screening, 1710 studies were excluded as they were not relevant to the review. Ninety-four studies were excluded following the assessment of full-text articles and five studies were included in this review (figure 1). Two studies were RCTs<sup>22 23</sup>; one was a quasi-experimental study<sup>24</sup>; and two were cross-sectional studies.<sup>25 26</sup>

The characteristics of the included studies are detailed in table 1. The studies were conducted in Lebanon (n=2), Iran (n=1), Brazil (n=1) and China (n=1) and comprised urban (n=3), rural (n=1) and mixed (n=1) location. The participants were aged 20 years and above. With sample size ranging from 184 to 7192, the participants were enrolled from healthcare settings (n=2), communities (n=2) and workplace (n=1).

All the included studies employed intervention strategies targeting patients only. The various intervention strategies used included one-on-one education (n=2),<sup>22 26</sup> group education (n=2),<sup>22 24</sup> mass media (n=2),<sup>25 26</sup> small media (n=4),<sup>22 24–26</sup> reducing clients' out-of-pocket costs (n=2),<sup>24 25</sup> reducing structural barriers (n=2),<sup>24 26</sup> client reminders (n=2)<sup>22 23</sup> and engaging community health workers (CHWs) (n=1).<sup>26</sup> Most studies (n=4) used multi-component strategies<sup>22 24–26</sup> (table 1). Except for two

studies<sup>22 24</sup> in which there was no information on the cost of mammography screening, mammography screenings were covered by health insurance,<sup>26</sup> discounted<sup>25</sup> and provided free in a mass screening.<sup>23</sup> Navigation assistance was provided in only two of the studies in the form of a provision of mobile mammography unit,<sup>23</sup> arrangement of appointment and transportation to the mammography site,<sup>24</sup> workplace financial support<sup>24</sup> and release time for mammograms.<sup>24</sup>

There were unclear risks for the RCTs assessed with the Cochrane ROB tool as there was no information regarding the concealment of allocation sequence of participants to interventions (table 2).

Using the EPHPP tool, we rated the quasi-experimental study and cross-sectional studies as strong and weak studies, respectively, following the global rating (table 3).

The selected studies used multiple and highly diversified intervention strategies; thus, it was difficult to estimate the effects of each intervention strategy. Consequently, evidence that supports the overall effectiveness of the intervention strategies was reported instead of individual interventions. The highlight of each intervention was discussed as follows.

**Table 2** Revised Cochrane risk-of-bias tool criteria for quality assessment of randomised controlled trials

Reference	Randomisation process	Deviations from intended interventions	Missing outcome data	Measurement of the outcome	Selection of the reported result	Overall risk of bias
Lakkis <i>et al</i> <sup>23</sup>	Some concerns	Low risk	Low risk	Low risk	Low risk	Some concerns
Taymoori <i>et al</i> <sup>22</sup>	Some concerns	Low risk	Low risk	Low risk	Low risk	Some concerns

**Table 3** EPHPP quality assessment criteria for quantitative studies

Reference	Selection bias	Study design	Confounders	Blinding	Data collection method	Withdrawals and dropouts	Global rating*
Ma <i>et al</i> <sup>24</sup>	1	1	1	2	1	1	1
Adib <i>et al</i> <sup>25</sup>	2	3	3	2	1	2	3
Mauad <i>et al</i> <sup>26</sup>	3	3	3	2	1	2	3

\*EPHPP Global rating is as follows: 1, strong (no weak ratings); 2, moderate (one weak rating); 3, weak (two or more weak ratings). EPHPP, Effective Public Health Practice Project.

### Individual-based interventions

#### Short message service (SMS) text reminders

A study<sup>23</sup> that employed SMS-text reminders, containing an invitation to a mammogram screening, found that there was no statistically significant difference in use of mammography between the two subgroups; subgroup 1 received an invitation to a mammogram test and subgroup 2 received in addition to the invitation, an informative SMS-text about the benefits of mammogram screening. At 6 month post-intervention follow-up, 30.7% and 31.6% of the respective subgroups underwent a mammogram screening (table 4).

#### Community-based interventions

A community-based study in Lebanon used awareness campaigns as the primary intervention.<sup>25</sup> The study created awareness majorly through media (eg, pamphlets, educational compact disc, street signs, billboards, pink ribbons, radio and television adverts, television talk shows, SMS text advert and internet campaign banners) and provided a discount price for mammography screening in the participating centres during the campaign month. Use of mammography was shown to slightly increase from 11% to 18%, with the rate of use of mammography greater in urban and suburbs (25%) than in rural areas (14.1%). Use of mammography was also greater among women aged 40–59 years (43.3%) compared with younger (12.4%) or older women (11.4%) (table 4).

Similarly, a community-based study in Brazil that employed mobile mammography unit used the following community outreach strategies to reach out to eligible women: distribution of fliers and pamphlets, media broadcasts (via radio and loudspeakers) and community healthcare agents (CHCAs) making home visits.<sup>26</sup> The study showed that home visits by CHCAs accounted for the majority (47.4%) of mammogram attendance, while the remainder was due to radio advertisements (13.2%) and neighbourhood notifications (8.8%). Also, 13.3% of the estimated eligible female population were effectively screened (table 4).

#### Group-based teaching/training

##### Health education model-based interventions

An Iranian study employed tailored educational intervention based on the health belief model (HBM) and the theory of planned behaviour (TPB).<sup>22</sup> It consisted of

group sessions and individual sessions tailored to women's specific needs. The session formats included multimodal lectures with educational resources, such as films, slides, pamphlets and role modelling. Mammography screening rates was significantly increased among the TPB participants (adjusted OR (aOR) 6.58, 95% CI 2.80 to 15.47,  $p < 0.001$ ) and the HBM participants (aOR 5.11, 95% CI 2.26 to 11.52,  $p < 0.001$ ) relative to control participants. A second model which assessed only the interventions with the HBM as the referent group showed a comparable rate of using mammography (aOR 1.24, 95% CI 0.58 to 2.6,  $p = 0.58$ ), implying that the HBM and TPB model combination was more effective than HBM alone (table 4).

A Chinese workplace-based study employed educational intervention based on the HBM and social cognitive theory, with the intervention group receiving motivational group discussion, dynamic group interaction and role-play discussion sessions, printed educational handouts, and mammography navigation assistance.<sup>24</sup> The study revealed a significant increase in mammography screening rates, for participants who reported not having ever had mammogram screening at baseline, at 6 months post intervention from 10.3% to 72.7%, for the intervention group.<sup>24</sup> In contrast, a decrease in mammography screening rates from 5.9% to 4.7% was observed in the control group. Using the intention-to-treat analysis, the screening rates were 69% and 4.1% for the intervention and control groups, respectively (table 4).

### DISCUSSION

This systematic review was the first for the LMICs setting to identify interventions that could possibly improve mammography screening, which would be an invaluable step to increase its use and improve health outcomes. The review showed that several interventions can increase the uptake of mammography in women in LMICs. Heterogeneity in the study designs and interventions limited the statistical pooling of data. The included studies aimed to increase use of mammography using mostly educational and multicomponent interventions. Though most of the included studies,<sup>23 25 26</sup> except for two studies,<sup>22 24</sup> did not describe the theoretical basis of the evaluated interventions, the implicit theory for most educational interventions is that education can increase knowledge of breast

**Table 4** Intervention characteristics and findings

Reference	Intervention characteristics	Findings
Lakkis <i>et al</i> <sup>23</sup>	Content: invitation to do a mammogram Method of delivery: SMS text spaced over a period of 4 weeks Subgroup 2: received an additional informative SMS text on the benefits of a mammogram screening	<ul style="list-style-type: none"> <li>▶ The response group was not statistically different between the two subgroups at 6 months (<math>p \geq 0.05</math>).</li> <li>▶ Subgroup 1: 30.7% had a mammogram.</li> <li>▶ Subgroup 2: 31.6% had a mammogram.</li> </ul>
Taymoori <i>et al</i> <sup>22</sup>	Content: perceived threat of breast cancer, perceived benefits of mammography, perceived barriers of mammography, self-efficacy, perceived control and subjective norms Method of delivery: spoken/written materials Delivered by research staff Group education: eight group sessions (45–60 min) at weeks 1–6, 8–9 and 10–13 for the HBM and TPB interventions. The TPB group additionally underwent four sessions focused on subjective norms and perceived behavioural control. In addition, they received signed reminder messages regarding scheduling mammography appointments. Control group: completed surveys at 3 months prior to and 6 months following the intervention. Furthermore, they received pamphlets after they completed the follow-up questionnaire.	<ul style="list-style-type: none"> <li>▶ Significant increased mammography screening rates was found among the HBM and TPB groups relative to the control group. TPB group: aOR 6.58, 95% CI 2.80 to 15.47, <math>p &lt; 0.001</math>; HBM group: aOR 5.11, 95% CI 2.26 to 11.52, <math>p &lt; 0.001</math>.</li> <li>▶ A second model assessing only the two interventions with HBM as the referent group showed comparable rates of screening mammography (aOR 1.24, 95% CI 0.58 to 2.6, <math>p = 0.58</math>).</li> </ul>
Ma <i>et al</i> <sup>24</sup>	Content: overview of BC in China, BC risk factors for Chinese women in workplace, benefits of BC screening, cultural perceptions and traditional health beliefs about BC including physical and social barriers, self-initiated prevention strategies in BC, workplace leadership role in employee encouragement and empowerment in BC prevention and programme sustainability Method of delivery: spoken/written materials Motivational group education, dynamic group interaction and role-play discussion sessions, printed educational handouts, mammography navigation assistance that included arrangement of appointment, transportation, financial support and release time for mammograms Control group: received general healthcare education with focus on healthy lifestyle and disease prevention through routine healthcare examinations, printed materials, delayed BC education intervention and mammography navigation after 6 months' assessment	<ul style="list-style-type: none"> <li>▶ Exposure to workplace intervention significantly increased use of mammography from 10.3% at baseline to 72.7% at 6-month follow-up in the intervention group (<math>p &lt; 0.0001</math>).</li> <li>▶ The control group had a decrease in use of mammography from 5.9% at baseline to 4.7% at 6-month follow-up.</li> </ul>
Adib <i>et al</i> <sup>25</sup>	Content: FAQs on breast cancer risk factors, signs, detection and prognosis, promotion of annual mammography screenings among asymptomatic women aged 40 years and older Method of delivery: spoken/written materials. Media: pamphlets, educational CD, street signs, bill boards, pink ribbon, radio and TV adverts, TV talk shows, SMS text adverts, campaign banners on the homepage of major internet service providers. Educational CD with a standard presentation was used by healthcare providers for lectures and presentations in community centres and social clubs Discount price of about US\$27 or less was given during the campaign month for mammography in participating centres.	<ul style="list-style-type: none"> <li>▶ Overall proportion of 'proper' use slightly increased from 11% to 18% over 4 years.</li> <li>▶ Use of mammography was greater among women aged 40–59 years (43.3%) compared with younger (12.4%) or older women (11.4%).</li> <li>▶ Rate of use of mammography was greater in the cities and suburbs (25%) than rural areas.</li> </ul>
Mauad <i>et al</i> <sup>26</sup>	Content: breast cancer awareness Method of delivery: spoken/written materials broadcasts by radio and loudspeaker cars, distribution of flyers, pamphlets and advertising posters to local public health facilities, GP notifications and home visits by CHCAs A mobile mammogram unit was used for the study.	<ul style="list-style-type: none"> <li>▶ Home visits by CHCAs accounted for 47.4% attendance to mammogram screening.</li> <li>▶ The remainder were due to radio advertisements (13.2%), neighbourhood notifications (8.8%), scheduled follow-up (7.6%), GP (7%), loudspeaker car (3.6%) and others (12.5%).</li> <li>▶ The percentage of women effectively screened for the estimated population was 13.3%.</li> </ul>

BC, breast cancer; CD, compact disc; CHCA, community healthcare agent; GP, general practitioner; HBM, health belief model; SMS, short message service.

cancer, change risk perception and consequently result in behavioural change. Of the included studies, four significantly increased mammography screening uptake following intervention implementation.<sup>22–24–26</sup> The reviewed studies employed intervention strategies that were consistent with the CPSTF recommended approach of increasing community demand and access. However, none of the studies employed the CPSTF strategies of increasing provider delivery.

Mass media, including television, radio, billboards and small media including videos and printed materials such as pamphlets, flyers, letters or newsletters, communicate educational and motivational information about cancer screening. Though mass media can be used alone, its use should include other components or maximise existing interventions and infrastructure, as there is insufficient evidence to determine the effectiveness of mass media alone in increasing screening for breast cancer,<sup>6–27</sup> contrary to the use of small media.<sup>6–28</sup> Our review revealed that mass media (radio, television, street signs, billboards, educational compact disc and internet campaign banners)<sup>25–26</sup> and small media (pamphlets, flyers, advertising posters and printed educational handouts),<sup>24–26</sup> in conjunction with other interventions, significantly increased rate of using mammography. This finding is supported by a review from HICs in which media education, together with lay health worker (LHW) intervention, significantly increased use of mammography.<sup>29</sup>

Group education, delivered by either healthcare workers, lay health advisors or trained volunteers, delivers information to individuals to inform, encourage and influence them to seek recommended screening. The review revealed that tailored group education significantly increased the rate of using mammography.<sup>22–24</sup> This is consistent with the CPSTF evidence that group education is effective in increasing breast cancer screening<sup>30</sup> and another review, from HICs and LMICs, in which women who were involved in group education had a higher rate of mammography screening compared with those who were individually educated.<sup>31</sup>

Reduction of client out-of-pocket costs and structural barriers, such as the provision of discounts on the price of mammography, the use of mobile mammography van and the provision of mammography navigation assistance, contributed to an increased rate of using mammography.<sup>25–26</sup> This is also consistent with the CPSTF evidence of the proven effectiveness of both strategies in increasing screening for breast cancer.<sup>32–33</sup> Comparably, access-enhancing interventions such as mobile mammography vans and cost vouchers were reported to significantly increase mammography screening in previous reviews.<sup>12–13–15–17–34</sup> With access-enhancing interventions, the economic and structural barriers are minimised.

Engaging CHWs through home visits, which is a proven effective intervention according to the CPSTF evidence,<sup>9</sup> accounted for a significant increase in the use of mammography.<sup>26</sup> Similar to this finding, a systematic review of mammography educational interventions

in HICs showed that home visits significantly increased mammography screening, except for a study that offered mammography education to elderly women living in public housing.<sup>13</sup>

Though there is strong evidence of the effectiveness of the use of client reminders, written or telephone messages, to increase breast cancer screening,<sup>35</sup> the review showed a non-significant increase in use of mammography rate using SMS-text reminders.<sup>23</sup> This might be as a result of the content of the SMS-text, gain-framed message, as a short SMS-text reminder was found to be equivalent to a longer one in improving mammogram screening uptake. Contrary, loss-framed messages together with phone calls caused a dramatic significant increase in use of mammography in another review.<sup>36</sup> The non-significant increase might also be due to the use of a single intervention, as multicomponent interventions are more effective in increasing mammography uptake.<sup>13–14–36</sup>

With the majority of the studies having a relatively short follow-up period of 6 months<sup>22–24</sup> and the remainder<sup>24–26</sup> having no follow-up period, the long-term impact of these client-oriented interventions is not known. There is a high possibility of a decrease in mammography screening rates after an intervention gets translated and diluted into regular practice.<sup>37</sup> This suggests the need for evaluating the long-term effect of these interventions on use of mammography. Additionally, none of the included studies employed provider-oriented interventions. Several studies conducted in HICs indicate that provider-oriented interventions are effective in increasing use of mammography.<sup>38–42</sup> The interventions include physician reminders<sup>38–41–42</sup> or office system prompts,<sup>38</sup> audits/assessments with feedback,<sup>38–41</sup> referral services,<sup>39</sup> reorganisation of the clinic,<sup>38</sup> and educational sessions and materials.<sup>38–40</sup> The non-use of provider-oriented interventions might be due to factors such as feasibility, resources and expertise.

While some interventions highlighted previously were promising to adopt, it is unclear how they will perform in a real-life setting especially when other implementation outcomes as highlighted by the Proctors framework are considered.<sup>43</sup> The acceptability of the interventions is key, especially for the healthcare providers who will be at the forefront of implementing the interventions. The time and already hectic schedule of healthcare providers should be duly considered. Appropriateness of the intervention for a given practice setting, provider or consumer is another key implementation outcome to be considered. Here, the perceived fit, relevance or compatibility of the intervention for a given practice setting, provider or consumer will be considered. For example, will the intervention be a good fit to be implemented in the hospital setting? Is the intervention consistent with the providers' skill set, role or job expectations? Cost of implementation, another key implementation outcome, varies widely because of complexities in the costs of the particular intervention, the implementation strategies used, and the location of service delivery. The affordability of the intervention

should be considered, likewise the cost bearer (eg, individual or government), especially as few are covered by health insurance. Feasibility as well as the fidelity of the intervention should also be considered. At this point, the resources and training requirements needed for implementation of the intervention, likewise the degree to which an intervention was implemented as prescribed in the original protocol or as was intended by the developers, will be duly considered. Future studies should holistically study other implementation outcomes of the intervention to get an idea of the intervention's applicability in real-life LMIC settings and not just in controlled study environments. A pilot implementation of the interventions by policymakers should also be considered to validate the implementation outcomes before considering a large-scale adoption.

Several limitations of this systematic review were identified. First, only articles published in the English language were included in the review due to resource constraints. With very few studies being consistent with our inclusion criteria, a validity check was performed by not limiting our search to the English language, but the number of eligible studies remained the same. Second, most studies included in this review employed multicomponent intervention, making it difficult to establish the effect of the individual component. In addition, the heterogeneity in the study designs and interventions employed in the included studies made it impossible to undertake a meta-analysis to investigate quantitatively the effectiveness of any intervention. Finally, few studies were available for the review limited evidence regarding the effectiveness of interventions and hence the generalisability of the results of this review. It will be valuable to repeat this review as more studies become available.

Given the limited available evidence in LMICs, it would be pertinent to conduct more observational studies to identify more interventions and possibly increase the level of evidence of the identified interventions. Further studies can implement or further develop strategies aimed at increasing mammography screening uptake.

## CONCLUSION

Various client-oriented interventions, including mass media, small media, group education, engagement of CHWs, client reminders and reduction of clients' out-of-pocket expenses and structural barriers, aimed to increase the uptake of mammography screening among women in LMICs were identified. The use of multicomponent interventions was common and significantly effective in increasing the use of mammography screening than a single intervention. The knowledge obtained from this review can be used to design an extensive mammography screening programme aimed at disseminating information on breast cancer and its screening to larger communities.

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