BMJ Open

Interventions to increase mammography screening uptake among women living in low- and middle-income countries: A protocol for a systematic review.

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-056901
Article Type:	Protocol
Date Submitted by the Author:	30-Aug-2021
Complete List of Authors:	Nduka, Ifeoma; Nnamdi Azikiwe University, Department of Clinical Pharmacy and Pharmacy Management; Nnamdi Azikiwe University, Research Group for Evidence-Based Health Care Ejie, Izuchukwu; Nnamdi Azikiwe University, Department of Clinical Pharmacy and Pharmacy Management; Nnamdi Azikiwe University, Research Group for Evidence-Based Health Care Okafor, Charles; Griffith University School of Medicine, Centre for Applied Health Economics; Menzies Health Institute Eleje, George; Nnamdi Azikiwe University Teaching Hospital, Department of Obstetrics and Gynaecology; Nnamdi Azikiwe University, Effective Care Research Unit, Department of Obstetrics and Gynaecology Ekwunife, Obinna Ikechukwu; Nnamdi Azikiwe University, Department of Clinical Pharmacy and Pharmacy Management; Nnamdi Azikiwe University, Research Group for Evidence-Based Health Care
Keywords:	Breast tumours < ONCOLOGY, PUBLIC HEALTH, HEALTH ECONOMICS

Interventions to increase mammography screening uptake among women living in low- and middle-income countries: A protocol for a systematic review

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Keywords Mammography screening; Client-oriented interventions; Provider-oriented interventions; Low-income; Middle-income

Word count: 2200 words

Title

Interventions to increase mammography screening uptake among women living in low- and middle-income countries: A protocol for a systematic review

ABSTRACT

Introduction Breast cancer is the most prevalent cancer and the second leading cause of cancer-related deaths among women in low and middle-income countries (LMICs) including sub-Saharan Africa. Mammography screening is the most effective screening method for the early detection of breast cancers in asymptomatic individuals and the only screening test that decreases the risk of breast cancer mortality. Despite the perceived benefits, it has a low utilization rate in comparison with breast self-examination and clinical breast examination. Several interventions to increase the uptake of mammography have been assessed, as well as systematic reviews on mammography uptake. Nonetheless, none of the published systematic reviews focused on women living in low- and middle-income countries. The review aims to identify interventions that increase mammography screening uptake among women living in low and middle-income countries.

Methods and analysis Relevant electronic databases will be systematically searched from January 1, 1990 to June 30, 2021 for published and grey literature, including citation and reference list tracking, on studies focusing on interventions to increase mammography screening uptake carried out in LMICs and written in the English language. The search will incorporate the key terms: mammography, interventions, low- and middle-income countries, and their associated synonyms. Randomized controlled trials (RCTs), observational studies, and qualitative and mixed methods studies of interventions (carried out with and without comparison groups) reporting interventions to increase mammography screening uptake in LMICs will be identified, data extracted and assessed for methodological quality by two independent reviewers with disagreements to be resolved by consensus or by a third author. We will use narrative synthesis and/or meta-analysis depending on the characteristics of the data.

Ethics and dissemination Ethical approval is not required as it is a protocol for a systematic review. Findings will be disseminated through peer-reviewed publications and conference presentations.

PROSPERO registration number CRD42021269556

Strengths and limitations of this study

- This systematic review focuses on mammography screening uptake studies conducted in women living in low- and middle-income countries.
- There are no restrictions on the types of study.
- Findings can highlight the need to implement existing strategies or further develop strategies aimed at increasing mammography screening uptake.
- Non-English electronic databases will not be searched.

INTRODUCTION

Cancer, a leading cause of death, is an important hurdle to increasing life expectancy globally. With the rapidly growing incidence and mortality of cancers, female breast cancer is presently the most commonly diagnosed cancer globally, with an estimated 2.3 million cases (11.7%) as well as responsible for 6.9% of cancer-related deaths[1,2]. In low and middle-income countries (LMICs) including sub-Saharan Africa (SSA), breast cancer is the most prevalent cancer and the second leading cause of cancer-related deaths among women after cervical cancer[3]. The incidence of breast cancer remains high in high-income countries (HICs) in comparison with LMICs.[4,5] Notwithstanding, there is a rise in both the number of incident cases and age-specific incident rates in LMICs.[5] Regardless of the difficulty in estimating the exact incidence of cancer, including breast cancer in SSA, available data provided strong evidence suggestive of increased incidence of breast cancer in SSA with an average incidence of 33.8 per 100,000 women per year.[6] The mortality rates of breast cancer in LMICs are marginally higher than in HICs,[4,7,8] likewise, the case fatality rates from breast cancer seems to be significantly higher in LMICs than in HICs.[5,9] LMICs have low 5-year survival rates of breast cancer of about 53% compared with over 85% in HICs.[3,10]

Stage distribution at breast cancer diagnosis defines the prognosis of cancer and its treatment.[3,7-11] Breast self-examination (BSE), clinical breast examination (CBE), and mammography are the most commonly used breast cancer screening methods globally[12,13]. Mammography screening is the most effective screening method for the early detection of breast cancers in asymptomatic individuals[14] and the only screening test that decreases the risk of breast cancer mortality[15]. While developed countries have implemented population-based mammography screening programs[16], it is not yet available in most LMICs, including sub-Saharan Africa due to very limited resources.[3,5]

Mammography screening obtainable in few countries of SSA is frequently only accessible by women in urban centers. There are prohibitive out-of-pocket expenses associated with travel and accommodation for women living in semi-urban or rural settings[17]. Generally, mammography has a low utilization rate in comparison to breast self-examination and clinical breast examination[17,18]; this might be as a result of the unaffordable cost of mammography screening despite the perceived benefits.[7]

There are various intervention strategies to increase breast cancer screening. The Community Preventive Services Task Forces (CPSTF) categorized intervention strategies into the following: client-oriented interventions, provider-oriented interventions, and informed decision making[1920]. Client-oriented interventions such as client reminders[21], group education[22], one-on-one education[23], reducing clients' out-of-pocket costs[24], reducing structural barriers[25], and small media[26] are recommended by CPSTF as strategies to increase breast cancer screening. Provider-oriented interventions such as provider assessment and feedback[27] and provider reminder and recall system[28] are interventions that increase screening for breast cancer. Meanwhile, there is insufficient evidence to determine the effectiveness of using client incentives[29], mass media[30] as well as provider incentives[31] to increase screening for breast cancer. Also, there is insufficient evidence to determine the effectiveness of informed decision-making interventions, targeted at individuals in healthcare settings, community members outside of healthcare settings, or healthcare systems and providers, in increasing screening for breast cancer[32]. The CPSTF recommends interventions that engage community health workers[33] and multicomponent interventions[34] to increase screening for breast cancer based on strong evidence of their effectiveness.

Although interventions to increase uptake of mammography screening have been assessed[35], the increases in uptake do not always occur equally. A previous systematic review[36] established that access-enhancing interventions were most effective in increasing mammography screening. Another systematic review[37] concluded that interventions that used peer educators, incorporated multiple intervention strategies, or provided easy access via vans, cost vouchers, or home visits were effective in increasing screenings in low-income women. Different systematic reviews concluded that multiple interventions were the most effective strategy in increasing mammography uptake in low-income women[38] and Asian women[39]. A review of trials[40] found that letter of invitation, mailed educational material, a phone call, and some combined actions (such as a letter

of invitation plus phone call and training activities plus reminders) seemed to increase uptake of mammography screening. A meta-analysis[41] and a systematic review[42] found that access-enhancing strategies followed by individually directed approaches such as individual counseling or education, client reminders, and small media were effective in improving mammography uptake among ethnic minority women.

The studies included in the systematic review[38] of interventions to increase the uptake of mammography amongst low-income women were all conducted in high-income countries. In all published systematic reviews on interventions to increase uptake of mammography screening, we found none focused on women living in low- and middle-income countries. Therefore, we aim to identify the interventions that increase mammography screening uptake in women living in low- and middle-income countries.

METHODS AND ANALYSIS

This protocol has been developed following the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) guidelines,[43] as shown in the PRISMA-P checklist. The systematic review is prospectively registered with PROSPERO. Reporting of the systematic review will be informed by Preferred Reporting Items for Systematic Review and Meta-Analysis guidance.[44]

Eligibility criteria

The inclusion and exclusion criteria will be guided by the PICOTS (Problem or population, Interventions, Comparisons or Control, Outcome, Time frame, and Study design) framework.

Population

Studies whose population included asymptomatic women eligible for mammography screening will be included. We will exclude studies involving women with a prior diagnosis of breast cancer, women who have had a mastectomy, and women living outside low- and middle-income countries.

Interventions

Studies on client-oriented interventions such as client reminders, group education, one-on-one education, small media, mass media, and client incentives will be included. Studies on provider-

oriented interventions such as provider reminder and recall systems, provider assessment and feedback, and provider incentives will also be included.

Comparison

Studies with or without a comparator group will be included. The comparator group will be women who receive no active intervention or usual care (routine standard screening services such as breast self-examination or clinical breast examination).

Outcomes

We will include studies with reported uptake of mammography screening as a result of the interventions.

Time frame

Studies on interventions to increase mammography screening uptake published between January 1, 1990 and June 30, 2021 from low- and middle-income countries will be included.

Study design

Studies performed in low- and middle-income countries are eligible for inclusion. We will include studies that employed quantitative, qualitative or mixed-method study design. Further, only studies published in the English language will be considered.

Information sources/ Search strategy

Published, unpublished and grey literature in the English language will be searched. The search strategy will be developed in collaboration with a medical librarian. Medical Subject Heading (MeSH) and free-text terms will be developed and combined to identify published studies on MEDLINE via the OVID interface. The search strategy will then be adapted for EMBASE, Global Health, CINAHL, ASSIA, PsycINFO, Web of Science, Cochrane Central Register of Controlled Trials (CENTRAL), and Google Scholar. Truncation commands (using root words to capture alternative word endings), proximity operators (for words within a chosen distance of each other), and Boolean logic operators (OR and AND) will be used, and to ensure maximum yield, a preliminary trial with search terms will be conducted and refined. We will search African regional databases, including African Index Medicus (AIM), African journal online (AJOL), and African

Organisation for research and training in cancer (AORTIC), Open Grey and ProQuest Dissertations, and Theses Global databases will be searched for more published, unpublished and grey literature. Additional papers will be located through hand-searching of citations and reference list tracking, and contacts with authors and experts in the field for further information.

Selection process

The searched studies identified by electronic database searches will be saved in the EndNote library. After de-duplication, the titles and abstracts of the studies will be screened independently by two reviewers with disagreements to be resolved by consensus or by a third author. Full-text of articles will be retrieved and two reviewers will independently assess the studies for eligibility of inclusion into the review. Disagreements will be resolved by discussion, 10% of the selected studies will be checked by a third reviewer for consistency. The reasons for the exclusion of those studies screened in the full text will be documented.

Data extraction

Two independent reviewers will perform data extraction using a pre-defined data extraction form, and differences between reviewers will be resolved by discussion and mutual agreement. Key characteristics of the studies of the review to be extracted include:

1. Author, publication year, and funding source
2. Journal citation
3. Period of study (by year)
4. Country of study/study setting
5. Study population (characteristics and total number enrolled)
6. Intervention details (types of intervention, the role of intervention, duration of intervention, duration of follow-up), primary outcomes including descriptive statistics, odds ratio (OR), or risk ratio (RR).

Quality assessment and Risk of bias within studies

We will adapt and use the quality assessment tools listed in table 1. The results of methodological assessments of each study will be reported in narrative forms and tables. The overall quality of the entire set of included studies cannot be merged due to variations in tools and assessment methods. Disagreements that arise between the reviewers will be resolved through discussion.

Table 1: Quality assessment tools for various study designs

Tools	Study design
Cochrane risk of bias tool **EPHPP tools**[45]	Randomized controlled trials Cohort studies (one group pre + post (before and after)) Case-control studies Controlled clinical trials Cross-sectional studies Other non-randomized studies of intervention
CASP checklist[46]	Qualitative studies (e.g. focused group discussions, interviews)
MMAT tools[47]	Mixed method studies
*EPHPP – effective public health practice project *CASP – critical appraisal skills programme *MMAT – mixed methods appraisal tool	

Data synthesis

Due to the expected heterogeneity in the studies, we will first conduct a narrative synthesis of data from included studies according to Popay et al.[48] We will conduct a meta-analysis of data from included studies, if possible. Our primary analyses will pool overall summary effects by intervention type to determine the effectiveness of different interventions for increasing uptake of mammography screening. Heterogeneity will be assessed by Cochrane Q statistics and the I^2 statistics. A $p < 0.05$ will be considered to be significant for the Q statistical test and $I^2 > 75\%$ will represent substantial heterogeneity. Depending on the data collected, odds ratio (OR) or relative risk ratio will be the outcome measure. The choice of a random-effects model or a fixed-effects

model for a meta-analysis will depend on the level of heterogeneity. We will conduct exploratory subgroup analyses by intervention type, if possible. A persistent high degree of heterogeneity (I^2 > 75%) after exploring the sub-groups will prevent a meta-analysis. Meta-bias assessment will be performed using Egger's test and visualized with a funnel plot. We will also conduct a sensitivity analysis. The Review Manager Software Version 5.4 will be used for analysis.

Patient and Public Involvement

No patient involved

Ethics and dissemination

No formal ethical approval or informed consent will not be required for this study. In accordance with the PRISMA-P guidelines, the study is registered with PROSPERO.[49] The findings of this study will be disseminated through publishing in peer-reviewed journals; presentations at conferences, and seminars.

Authors' contributions: IJN, and OIE conceived this systematic review. IJN drafted the protocol. OIE, ILE, CEO, and GUE reviewed the protocol and provided extensive feedback. IJN registered the protocol with PROSPERO. All authors read and approved the final manuscript.

Funding: This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests: None declared.

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PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	3
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	5
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	5
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	6
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	6
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	7
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	7
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	7
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	7
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	8
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	8
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	8
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	8
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	8
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	8
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	9
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	8
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	8

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Reported on page #
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	N/A
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	N/A
Study characteristics	17	Cite each included study and present its characteristics.	N/A
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	N/A
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	N/A
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	N/A
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	N/A
	23b	Discuss any limitations of the evidence included in the review.	N/A
	23c	Discuss any limitations of the review processes used.	N/A
	23d	Discuss implications of the results for practice, policy, and future research.	N/A
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	2
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	2
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	9
Competing interests	26	Declare any competing interests of review authors.	9
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	9

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: http://www.prisma-statement.org/

BMJ Open

Interventions to increase mammography screening uptake among women living in low- and middle-income countries: A protocol for a systematic review.

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-056901.R1
Article Type:	Protocol
Date Submitted by the Author:	24-Jan-2022
Complete List of Authors:	Nduka, Ifeoma; Nnamdi Azikiwe University, Department of Clinical Pharmacy and Pharmacy Management; Nnamdi Azikiwe University, Research Group for Evidence-Based Health Care Ejie, Izuchukwu; Nnamdi Azikiwe University, Department of Clinical Pharmacy and Pharmacy Management; Nnamdi Azikiwe University, Research Group for Evidence-Based Health Care Okafor, Charles; Griffith University School of Medicine, Centre for Applied Health Economics; Menzies Health Institute Eleje, George; Nnamdi Azikiwe University Teaching Hospital, Department of Obstetrics and Gynaecology; Nnamdi Azikiwe University, Effective Care Research Unit, Department of Obstetrics and Gynaecology Ekwunife, Obinna Ikechukwu; Nnamdi Azikiwe University, Department of Clinical Pharmacy and Pharmacy Management; Nnamdi Azikiwe University, Research Group for Evidence-Based Health Care
Primary Subject Heading:	Oncology
Secondary Subject Heading:	Public health, Health economics
Keywords:	Breast tumours < ONCOLOGY, PUBLIC HEALTH, HEALTH ECONOMICS

Interventions to increase mammography screening uptake among women living in low- and middle-income countries: A protocol for a systematic review

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Keywords Mammography screening; Client-oriented interventions; Provider-oriented interventions; Low-income; Middle-income

Word count: 2346 words

Title

Interventions to increase mammography screening uptake among women living in low- and middle-income countries: A protocol for a systematic review

ABSTRACT

Introduction Breast cancer is the most prevalent cancer and the second leading cause of cancer-related deaths among women in low and middle-income countries (LMICs) including sub-Saharan Africa. Mammography screening is the most effective screening method for the early detection of breast cancers in asymptomatic individuals and the only screening test that decreases the risk of breast cancer mortality. Despite the perceived benefits, it has a low utilization rate in comparison with breast self-examination and clinical breast examination. Several interventions to increase the uptake of mammography have been assessed, as well as systematic reviews on mammography uptake. Nonetheless, none of the published systematic reviews focused on women living in low- and middle-income countries. The review aims to identify interventions that increase mammography screening uptake among women living in low and middle-income countries.

Methods and analysis Relevant electronic databases will be systematically searched from January 1, 1990 to June 30, 2021 for published and grey literature, including citation and reference list tracking, on studies focusing on interventions to increase mammography screening uptake carried out in LMICs and written in the English language. The search will incorporate the key terms: mammography, interventions, low- and middle-income countries, and their associated synonyms. Randomized controlled trials (RCTs), observational studies, and qualitative and mixed methods studies of interventions (carried out with and without comparison groups) reporting interventions to increase mammography screening uptake in LMICs will be identified, data extracted and assessed for methodological quality by two independent reviewers with disagreements to be resolved by consensus or by a third author. We will use narrative synthesis and/or meta-analysis depending on the characteristics of the data.

Ethics and dissemination Ethical approval is not required as it is a protocol for a systematic review. Findings will be disseminated through peer-reviewed publications and conference presentations.

PROSPERO registration number CRD42021269556

Strengths and limitations of this study

- This systematic review focuses on mammography screening uptake studies conducted in women living in low- and middle-income countries.
- There are no restrictions on the types of study.
- Findings can highlight the need to implement existing strategies or further develop strategies aimed at increasing mammography screening uptake.
- Non-English electronic databases will not be searched.

INTRODUCTION

Cancer, a leading cause of death, is an important hurdle to increasing life expectancy globally. With the rapidly growing incidence and mortality of cancers, female breast cancer is presently the most commonly diagnosed cancer globally, with an estimated 2.3 million cases (11.7%) as well as responsible for 6.9% of cancer-related deaths.[1,2] In low and middle-income countries (LMICs) including sub-Saharan Africa (SSA), breast cancer is the most prevalent cancer and the second leading cause of cancer-related deaths among women after cervical cancer[3]. The incidence of breast cancer remains high in high-income countries (HICs) in comparison with LMICs.[4,5] Notwithstanding, there is a rise in both the number of incident cases and age-specific incident rates in LMICs.[5] Regardless of the difficulty in estimating the exact incidence of cancer, including breast cancer in SSA, available data provided strong evidence suggestive of increased incidence of breast cancer in SSA with an average incidence of 33.8 per 100,000 women per year.[6] The mortality rates of breast cancer in LMICs are marginally higher than in HICs,[4,7,8] likewise, the case fatality rates from breast cancer seems to be significantly higher in LMICs than in HICs.[5,9] LMICs have low 5-year survival rates of breast cancer, ranging from 12% to 53%, compared with over 85% in HICs.[10,11]

Stage distribution at breast cancer diagnosis defines the prognosis of cancer and its treatment.[3,7-12] Breast self-examination (BSE), clinical breast examination (CBE), and mammography are the most commonly used breast cancer screening methods globally[13,14]. Mammography screening is the most effective screening method for the early detection of breast cancers in asymptomatic individuals[15] and significantly decreases the risk of breast cancer mortality by 15-56%.[16] Adherence to regular mammography examinations cannot be overemphasized, as it has been

shown to cause a reduction in risk of breast cancer mortality.[17] CBE is also important particularly for low resource settings as it has been shown to cause a 15% non-significant reduction in mortality.[18] While developed countries have implemented population-based mammography screening programs[19], it is not yet available in most LMICs, including sub-Saharan Africa due to very limited resources.[3,5] Mammography screening obtainable in few countries of SSA is frequently only accessible by women in urban centers. There are prohibitive out-of-pocket expenses associated with travel and accommodation for women living in semi-urban or rural settings[20]. Generally, mammography has a low utilization rate in comparison to breast self-examination and clinical breast examination[20,21]; this might be as a result of the unaffordable cost of mammography screening among other factors.[7]

There are various intervention strategies to increase breast cancer screening. The Community Preventive Services Task Forces (CPSTF) categorized intervention strategies into the following: client-oriented interventions, provider-oriented interventions, and informed decision making[22,23]. Client-oriented interventions such as client reminders[24], group education[25], one-on-one education[26], reducing clients' out-of-pocket costs[27], reducing structural barriers[28], and small media[29] are recommended by CPSTF as strategies to increase breast cancer screening. Provider-oriented interventions such as provider assessment and feedback[30] and provider reminder and recall system[31] are interventions that increase screening for breast cancer. Meanwhile, there is insufficient evidence to determine the effectiveness of using client incentives[32], mass media[33] as well as provider incentives[34] to increase screening for breast cancer. Also, there is insufficient evidence to determine the effectiveness of informed decision-making interventions, targeted at individuals in healthcare settings, community members outside of healthcare settings, or healthcare systems and providers, in increasing screening for breast cancer[35]. The CPSTF recommends interventions that engage community health workers[36] and multicomponent interventions[37] to increase screening for breast cancer based on strong evidence of their effectiveness.

Systematic reviews summarizing the impact of different interventions to increase uptake of mammography screening have been published.[38-45] A previous systematic review[39] established that access-enhancing interventions, interventions which improve access to and utilization of mammography such as transportation to appointments, facilitated scheduling, mobile vans, vouchers and reduced mammogram cost, were most effective in increasing mammography

screening. Another systematic review[40] concluded that interventions that used peer educators, incorporated multiple intervention strategies (i.e. more than one intervention in a study), or provided easy access via vans, cost vouchers, or home visits were effective in increasing screenings in low-income women. Different systematic reviews concluded that multiple interventions were the most effective strategy in increasing mammography uptake in women.[41, 42] A review of trials[43] found that letter of invitation, mailed educational material, a phone call, and some combined actions (such as a letter of invitation plus phone call and training activities plus reminders) seemed to increase uptake of mammography screening. A meta-analysis[44] and a systematic review[45] found that access-enhancing strategies followed by individually directed approaches such as individual counseling or education, client reminders, and small media were effective in improving mammography uptake among ethnic minority women.

The studies included in the systematic review[41] of interventions to increase the uptake of mammography amongst low-income women were all conducted in high-income countries. In all published systematic reviews on interventions to increase uptake of mammography screening, we found none focused on women living in low- and middle-income countries. Therefore, we aim to identify the interventions that increase mammography screening uptake in women living in low- and middle-income countries.

METHODS AND ANALYSIS

This protocol has been developed following the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) guidelines,[46] as shown in the PRISMA-P checklist. The systematic review is prospectively registered with PROSPERO.[47] Reporting of the systematic review will be informed by Preferred Reporting Items for Systematic Review and Meta-Analysis guidance.[48]

Eligibility criteria

The inclusion and exclusion criteria will be guided by the PICOTS (Problem or population, Interventions, Comparisons or Control, Outcome, Time frame, and Study design) framework.

Population

Studies whose population included asymptomatic women eligible for mammography screening will be included. We will exclude studies involving women with a prior diagnosis of breast cancer, women who have had a mastectomy, and women living outside low- and middle-income countries.

Interventions

Studies on client-oriented interventions such as client reminders, group education, one-on-one education, small media, mass media, and client incentives will be included. Studies on provider-oriented interventions such as provider reminder and recall systems, provider assessment and feedback, and provider incentives will also be included.

Comparison

Studies with or without a comparator group will be included. The comparator group will be women who receive no active intervention or usual care (routine standard screening services such as breast self-examination or clinical breast examination).

Outcomes

We will include studies with reported uptake of mammography screening as a result of the interventions.

Time frame

Studies on interventions to increase mammography screening uptake published between January 1, 1990 and June 30, 2021 from low- and middle-income countries will be included.

Study design

Studies performed in low- and middle-income countries are eligible for inclusion. We will include studies that employed quantitative, qualitative or mixed-method study design. Further, only studies published in the English language will be considered.

Information sources/ Search strategy

Published, unpublished and grey literature in the English language will be searched. The search strategy will be developed in collaboration with a medical librarian (Supplementary file). Medical Subject Heading (MeSH) and free-text terms will be developed and combined to identify published studies on MEDLINE via the OVID interface. The search strategy will then be adapted for

EMBASE, Global Health, CINAHL, ASSIA, PsycINFO, Web of Science, Cochrane Central Register of Controlled Trials (CENTRAL), and Google Scholar. Truncation commands (using root words to capture alternative word endings), proximity operators (for words within a chosen distance of each other), and Boolean logic operators (OR and AND) will be used, and to ensure maximum yield, a preliminary trial with search terms will be conducted and refined. We will search African regional databases, including African Index Medicus (AIM), African journal online (AJOL), and African Organisation for research and training in cancer (AORTIC), Open Grey and ProQuest Dissertations, and Theses Global databases will be searched for more published, unpublished and grey literature. Additional papers will be located through hand-searching of citations and reference list tracking, and contacts with authors and experts in the field for further information.

Selection process

The searched studies identified by electronic database searches will be saved in the EndNote library. After de-duplication, the titles and abstracts of the studies will be screened independently by two reviewers with disagreements to be resolved by consensus or by a third author. Full-text of articles will be retrieved and two reviewers will independently assess the studies for eligibility of inclusion into the review. Disagreements will be resolved by discussion, 10% of the selected studies will be checked by a third reviewer for consistency. The reasons for the exclusion of those studies screened in the full text will be documented.

Data extraction

Two independent reviewers will perform data extraction using a pre-defined data extraction form, and differences between reviewers will be resolved by discussion and mutual agreement. Key characteristics of the studies of the review to be extracted include:

1. Author, publication year, and funding source
2. Journal citation
3. Period of study (by year)
4. Country of study/study setting
5. Study population (characteristics and total number enrolled)

6. Intervention details (types of intervention, the role of intervention, duration of intervention, duration of follow-up), primary outcomes including descriptive statistics, odds ratio (OR), or risk ratio (RR).

Quality assessment and Risk of bias within studies

We will adapt and use the quality assessment tools listed in table 1. The results of methodological assessments of each study will be reported in narrative forms and tables. The overall quality of the entire set of included studies cannot be merged due to variations in tools and assessment methods. Disagreements that arise between the reviewers will be resolved through discussion.

Table 1: Quality assessment tools for various study designs

Tools	Study design
Cochrane risk of bias tool **EPHPP tools**[49]	Randomized controlled trials Cohort studies (one group pre + post (before and after)) Case-control studies Controlled clinical trials Cross-sectional studies Other non-randomized studies of intervention
CASP checklist[50]	Qualitative studies (e.g. focused group discussions, interviews)
MMAT tools[51]	Mixed method studies
***EPHPP – effective public health practice project** ***CASP – critical appraisal skills programme** ***MMAT – mixed methods appraisal tool**	

Data synthesis

Due to the expected heterogeneity in the studies, we will first conduct a narrative synthesis of data from included studies according to Popay et al.[52] We will conduct a meta-analysis of data from included studies, if possible. Our primary analyses will pool overall summary effects by

intervention type to determine the effectiveness of different interventions for increasing uptake of mammography screening. Heterogeneity will be assessed by Cochrane Q statistics and the I^2 statistics. A $p < 0.05$ will be considered to be significant for the Q statistical test and $I^2 > 75\%$ will represent substantial heterogeneity. Depending on the data collected, odds ratio (OR) or any other suitable summary statistics will be used as the outcome measure. The choice of a random-effects model or a fixed-effects model for a meta-analysis will depend on the level of heterogeneity. We will conduct exploratory subgroup analyses by intervention type, if possible. A persistent high degree of heterogeneity ($I^2 > 75\%$) after exploring the sub-groups will prevent a meta-analysis. Meta-bias assessment will be performed using Egger's test and visualized with a funnel plot. We will also conduct a sensitivity analysis. The Review Manager Software Version 5.4 will be used for analysis.

Patient and Public Involvement

No patient involved

Ethics and dissemination

No formal ethical approval or informed consent will not be required for this study. In accordance with the PRISMA-P guidelines, the study is registered with PROSPERO. The findings of this study will be disseminated through publishing in peer-reviewed journals, presentations at conferences, and seminars.

Authors' contributions: IJN, and OIE conceived this systematic review. IJN drafted the protocol. CEO developed the search strategy. OIE, ILE, CEO, and GUE reviewed the protocol and provided extensive feedback. IJN registered the protocol with PROSPERO. All authors read and approved the final manuscript.

Funding: This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests: None declared.

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Search strategy with Medline (OvidSp)

	Search	Results
1	Mammography/	30508
2	Mammograph* screen*.tw.	4324
3	breast screen*.tw.	2134
4	low-income*.tw.	31257
5	middle-income*.tw.	17290
6	Poverty.tw.	22234
7	(africa or asia or south america).tw.	148619
8	Reminder Systems/	3587
9	Patient Education as Topic/	86626
10	cost* reduc*.tw.	3949
11	Cost minimization.tw.	895
12	Cost saving	5851
13	Health Services Accessibility/	78027
14	barriers.tw.	111761
15	Communication/	86782
16	1 or 2 or 3	32072
17	4 or 5 or 6 or 7	208703
18	8 or 9 or 10 or 11 or 12 or 13 or 14 or 15	353569
19	16 and 17 and 18	173
20	limit 19 to yr="1990 -Current"	173

Search strategy with Medline (OvidSp)

	Search	Results
1	**mammography** AND **screening**	25,183
2	**breast** AND **screen***	80,192
3	**low** AND **income**	92,063
4	**middle** AND **income**	58,876
5	**poverty**	63,654
6	**africa** OR **asia**	558,564
7	**south** AND **america**	81,887
8	**reminders**	10,619
9	**patient** AND **education**	482,981
10	**cost** AND **saving**	22,294
11	**cost** AND **minimization**	5,663
12	**cost** AND **reduction**	75,344
13	**health** AND **service** AND **accessibility**	7,617
14	**barriers**	189,251
15	**communication**	632,107
16	#1 OR #2	82,140
17	#3 OR #4 OR #5 OR #6 OR #7	765,359
18	#8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15	1,320,247
19	#16 AND #17 AND #18	876
20	#16 AND #17 AND #18 AND [1990-2021]/py	872

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	3
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	5
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	5
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	6
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	6
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	7
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	7
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	7
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	7
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	8
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	8
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	8
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	8
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	8
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	8
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	9
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	8
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	8

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Reported on page #
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	N/A
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	N/A
Study characteristics	17	Cite each included study and present its characteristics.	N/A
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	N/A
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	N/A
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	N/A
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	N/A
	23b	Discuss any limitations of the evidence included in the review.	N/A
	23c	Discuss any limitations of the review processes used.	N/A
	23d	Discuss implications of the results for practice, policy, and future research.	N/A
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	2
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	2
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	9
Competing interests	26	Declare any competing interests of review authors.	9
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	9

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

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