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# Application of Health Education Intervention Models to Prevent Breast Cancer: A Systematic Review and Meta-Analysis

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**ABSTRACT**

**Introduction:** Self-examination behaviors and screening are essential for controlling breast cancer. Studies have demonstrated that interventions based on health education models and theories can improve self-examination and self-management behaviors among patients with breast cancer. However, there is no consensus on which education theory or model is most effective in promoting healthy behaviors for the prevention of breast cancer. This review aims to evaluate the effectiveness of health education and promotion theories and models on improving self-examination and self-management behaviors for breast cancer prevention.

**Methods:** Four databases (PubMed, Scopus, ProQuest, and ScienceDirect) were searched using relevant keywords related to health education and promotion theories and models. Studies published in English up to February 2020 were screened. Two independent reviewers assessed the eligibility and methodological quality of the included studies. All data were collected directly from the women participants.

**Results:** Fourteen studies were included in the systematic review, and seven were pooled in the meta-analysis. Both the meta-analysis and systematic review indicated that interventions grounded in health education theories or models significantly improved women's engagement in, and knowledge of, self-examination skills and self-management behaviors for breast cancer prevention. The Health Belief Model (HBM) was the most commonly used theoretical framework in educational interventions designed to enhance preventive health behaviors among women.

**Conclusion:** Our findings highlight the beneficial impact of theory-based health education interventions in motivating women to adopt self-examination and self-management behaviors contributing to the reduction of breast cancer-related morbidity and mortality.

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## Introduction

Breast cancer is one of the most common cancers among women worldwide (1) and remains the leading cause of cancer-related death in women globally (2). The estimated global annual incidence is 38.1 million cases (3), imposing a substantial burden on women's health and quality of life (4).

Despite significant advances in research and treatment, breast cancer continues to pose a major public health challenge and remains a top priority in biomedical research (5, 6). Its high incidence, coupled with the difficulty of treating advanced-stage disease, places a heavy burden on healthcare

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systems ,underscoring the urgent need for effective early detection strategies (7). One key strategy for preventing breast cancer and reducing mortality is breast self-examination (BSE), which is considered a simple, effective, and low-cost method for early detection (8). Given that women are central to family health and play a vital role in the socioeconomic fabric of society, early detection and prevention of breast cancer are among the most effective approaches to controlling the disease (9). Early diagnosis and timely intervention significantly improve treatment outcomes, reduce mortality and morbidity, and enhance women's quality of life (10). Numerous studies indicate that improving public awareness and fostering positive attitudes toward breast cancer can positively influence screening behaviors among women in the community (11).

Several studies have reported that appropriate and well-established health education theories and models are essential for designing effective and practical interventions aimed at the early detection of breast cancer (12, 13). A systematic review of these studies is therefore necessary to evaluate the effectiveness and efficacy of health education interventions, thereby providing a sound evidence base for selecting and implementing the most suitable theories and models (14).

Systematic reviews provide concise and reliable syntheses of research on a specific topic. Like primary studies, systematic reviews—including those incorporating meta-analysis—follow rigorous and predefined methodological standards.

Therefore, we conducted a systematic review and meta-analysis to evaluate the effectiveness of health education and promotion theories and models in improving breast self-examination and self-management behaviors for breast cancer prevention.

## Methods

### *Study Design*

This study is based on the guidelines of systematic review and meta-analysis (PRISMA) guidelines (15) (Figure 1) and the Cochrane collaboration tool (16), and the PICO framework.

The main research questions were:

1. Which theory or model is commonly used to improve preventive health behavior?
2. Can intervention based on health education theory improve preventive health behavior in women with breast cancer?
3. Can interventions improve patients' knowledge?

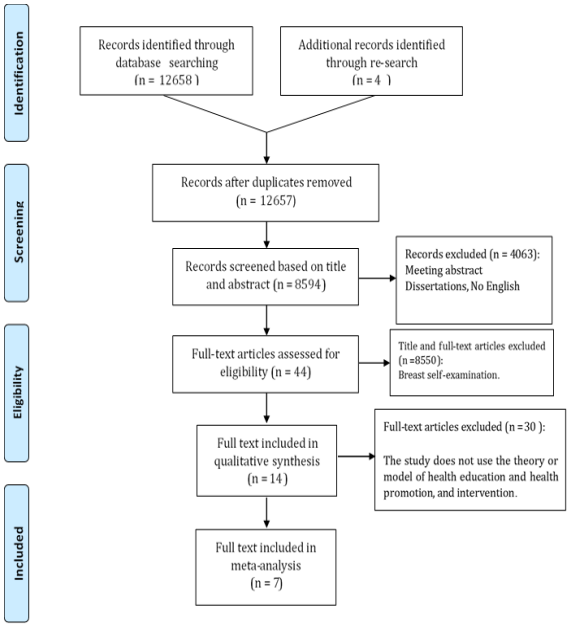


**Figure 1:** Flowchart of the systematic review process using the PRISMA checklist

### *2. Information Sources and Search Strategy*

We conducted the systematic search using an iterative process guided by the Cochrane Collaboration recommendations.

We searched articles from four scientific databases (PubMed, Scopus, ProQuest, and the Web of Science) without restrictions on publication year. The search dates started as follows for each database, and lasted for all databases on February 5, 2020. Search using the keywords "Breast Cancer", "models", "Theory", "Health Education", "Health Promotion", "intervention", "quasi-experimental", "semi-experimental", and "Randomized Controlled Trials" was done to retrieve articles in the English language.

### *3. Selection process: Inclusion and exclusion Criteria*

In this systematic review, we used PICO-SD guidelines (Participants, intervention, comparison, outcome, study design) to develop the criteria (Table 1).

**Table 1.** Inclusion and exclusion criteria

| | *Inclusion Criteria* | *Exclusion Criteria* |
|---|---|---|
| **Participants** | population (women) | individuals with intellectual disabilities or mental illness |
| **Study Type** | "intervention", "quasi-experimental", "semi-experimental", and "Randomized Controlled Trials". | Transversal descriptive studies |
| **Intervention** | All interventions are designed based on health education theories to increase awareness / promote preventive health behaviors of breast cancer in the women's population. This includes courses or training sessions using lectures and questions and answers, group discussion, and the use of teaching aids such as models, slide shows, educational videos, educational booklets, presentation of pictures, and Compact discs. And skills workshops to improve an individual's ability to promote healthy behaviors. | Health education theories were not specifically assessed—interventions, not specifically designed to improve breast self-examination. |
| **Comparison** | The comparison included all the studies applying or not applying the comparison, and all the studies applying or not applying the comparison strategy. | |
| **Setting** | Any type of socio-health setting and clinical, University centers | School setting; Mental health |
| **Outcomes** | - Significant increase in awareness breast self-examination skills<br>-Social and cognitive skills (self-efficacy, medication adherence, communication skills, self-care)<br>- Knowledge of the disease/problem,<br>- Self-control/management of health problems:<br>- Prevention: preventive behaviors and knowledge participation in preventive measures<br>- Overall state of health: quality of life, physiological indexes, etc. | |
| **Dissemination Type** | Scientific full-text articles published in indexed scientific journals and conferences | ---------- |
| **Language** | English | Articles written in languages other than English |
| **Others** | Published from ----<br>- Use of validated measures of breast self-examination and health outcome<br>- Assess the relationship between breast self-examination and health outcome;<br>- Identifiable effect size | |

The female population formed the participants (P) of the present meta-analysis. All interventions (I) are designed based on health education theories to increase awareness / promote preventive health behaviors of breast cancer in the women population. This includes courses or training sessions using lectures and questions and answers, group discussion, and the use of teaching aids such as models, slide shows, educational videos, educational booklets, presentation of pictures, and Compact discs. And skills workshops to improve an individual's ability to promote healthy behaviors. The comparison (c) included all the studies applying or not applying the comparison, and all the studies applying or not applying the comparison strategy.

The outcome (O) variables were the Significant increase in awareness breast self-examination skills, Social and cognitive skills (self-efficacy, medication adherence, communication skills, self-care), Knowledge of the disease/problem, Self-control/management of health problems, Prevention (preventive behaviors and knowledge participation in preventive measures), Overall state of health (quality of life, physiological indexes), etc. The Study Type (S) included all the studies: "intervention", "quasi-experimental", "semi-experimental", and "Randomized Controlled Trials".

## *Data extraction and quality appraisal (pilot)*

In this review, the following characteristics were extracted from all included article: the author (s)/studies year, the sample size, design, health education theories/models used, the most effective construct of theories/models, health outcome of the study, preventive behavior score/level, and the measure of association between preventive behavior and intervention strategies with corresponding P-values (Table 2). Two independent authors screened

titles and abstracts of all articles to select eligible articles (F.P. and B.T.). Then, the methodology and results sections of full-text articles were evaluated to determine eligibility. Articles were included if both authors confirmed their eligibility, and the third reviewer resolved any doubts and disagreements regarding the inclusion criteria and data extraction through discussions between the authors (N.P.). Likewise, we tested the quality of the included studies via the independent dual rating based on the Cochrane diagnostic test accuracy review.

**Table 2.** Characteristic Included Study

| *Code* | *Study* | *Sample size* | *Study design* | *Period of Study* | *Model/Theory* | *Result after intervention in the experimental group* |
|---|---|---|---|---|---|---|
| 1 | Kıssal (24) | 48 | Quasi-experimental | 1 Year | HBM | Significant increase in awareness and BSE skills at the 6-month and 1-year follow-ups. |
| 2 | Masoudiyekta (25) | 226 | Quasi-experimental | 3 month | HBM | Significant increase in knowledge, perceived severity and sensitivity, cause to action, perceived benefits, and self-efficacy, and a decrease in barriers |
| 3 | Khiyali (26) | 92 | Quasi-experimental | 3 month | HBM | Significant increase in knowledge, HBM constructs, and self-examination behavior. |
| 4 | Torbaghan (29) | 130 | Randomized Controlled Trials | 1month | HBM | Significant increase in awareness, perceived susceptibility and benefits, and behavior, and a decrease in barriers.<br>Positive linear relationship between perceived barriers and behavior (B = 0.183, t = 2.964, P = 0.04) |
| 5 | Rezaeian (30) | 290 | Randomized Controlled Trials | 4month | HBM | - Significant increase in perceived susceptibility, severity, benefits, and self-efficacy of mammography and health motivation, and a decrease in barriers |
| 6 | Farma (27) | 240 | Quasi-experimental | 2 month | HBM | Significant increase in perceived susceptibility and severity, benefits, and self-efficacy of mammography and health motivation, and decrease in barriers (P <0.0001). |
| 7 | Fathollahi-Dehkordi (31) | 107 | Randomized Controlled Trials | 3 month | HBM /TTM | Significant increase in knowledge, and all the health beliefs subscales scores, excluding barriers. |
| 8 | Ghahremani (28) | 168 | Quasi-experimental | ten weeks | TTM | Significant increase in the mean scores of trans-theoretical model constructs (stages of change, self-efficacy, decisional balance, and processes of change) and BSE behavior compared. |
| 9 | Ghaffari (37) | 138 | semi-experimental | 2 month | IBM | Significant increase in knowledge, behavioral intention, perceived susceptibility, severity, benefits, barriers, self-efficacy to mammography, BSE, and subjective norms. |
| 10 | Secginli(32) | 190 | randomized controlled trial | 6 month | HBM | Significant increase in BSE skills,<br>lump detection scores, breast health knowledge, perceived susceptibility, and benefits of BSE, mammography |
| 11 | Deavenport (33) | 210 | Randomized Controlled Trials | 1.5 month | HBM | Significant increase in perceived benefits of mammogram, self-efficacy, and perceived barriers |
| 12 | Hatchett (34) | 74 | Randomized Controlled Trials | 3month | SCT | - Significant increase in intensity level for survivors of breast cancer ($p < 0.001$)<br>Significant increase in mean days for moderate and vigorous exercise at 6 and 12 weeks.<br>Significant increase in intensity of exercise at 12 weeks and between groups on vigorous intensity exercise at 6 and 12 weeks |
| 13 | Zonouzy (36) | 600 | Randomized Controlled Trials | 3month | EPPM | Significant changes in attitude and behavioral intention |
| 14 | Scruggs (35) | 60 | Randomized Controlled Trials | 6 month | TTM | - Significant increase in perceived self-efficacy, use of self-liberation, counterconditioning, reinforcement management processes, and the progression stage |

**Abbreviation:** BSE, breast self-examination; CBE, clinical breast exam; EPPM, extended parallel process model; HBM, health belief model; IBM, integrated behavioral model; SCT, social cognitive theory; SMD, standardized mean difference; TTM, trans theoretical model.

### *Risk of Bias*

The Cochrane evaluation checklist was used to evaluate the quality of articles since all articles were of an intervention type (17). Biases in selection, performance, diagnosis, data collection, and reporting, and other biases were examined (18) (Table 3).

**Table 3:** Cochrane risk-of-bias summary for included

| Study | Adequate sequence generation | Allocation concealment | Blinding | Incomplete data addressed | Free of selective reporting | Free of other bias | Percent of "yes" answers |
|---|---|---|---|---|---|---|---|
| Kıssal (2019) | Y | N | N | N | Y | Y | 50 |
| Masoudiyekta (2018) | Y | ? | Y | N | ? | Y | 50 |
| Khiyali (2017) | Y | Y | N | Y | N | Y | 66 |
| Torbaghan (2014) | Y | ? | Y | N | Y | ? | 50 |
| Rezaeian (2014) | Y | N | Y | Y | Y | Y | 83 |
| Farma (2014) | Y | N | Y | N | Y | Y | 66 |
| Fathollahi- Dehkordi (2018) | Y | Y | ? | N | Y | Y | 50 |
| Ghahremani (2016) | Y | N | Y | Y | N | Y | 66 |
| Ghaffari (2018) | Y | Y | N | Y | Y | Y | 83 |
| Secginli(2011) | N | ? | Y | Y | Y | Y | 66 |
| Deavenport(2011) | Y | ? | Y | N | ? | Y | 50 |
| Hatchett (2013) | Y | N | N | Y | Y | Y | 66 |
| Zonouzy(2019) | Y | Y | N | ? | Y | Y | 66 |
| Scruggs (2018) | Y | A | ? | N | Y | Y | 50 |

Y=Yes; N= No; ?= Ambiguous

## Results

### *Study designs and populations*

Fourteen studies, including data from 2573 women, met our inclusion criteria. Sample sizes ranged from 48 to 600; four of the studies had fewer than 100 participants. They presented data collected from four countries (the USA, *S*pain, Turkey, and Iran), with 64% of studies conducted in Iran (Table 2).

### *Description of Included Results Systematic Review*

In this review, the effect of theories and models was examined using three types of study designs, including quasi-experimental studies (*5/14, 35%*) (19-23), randomized controlled trials (*8/14, 57%*) (24-31), and semi-experimental studies (*1/14, 7%*) (32). Overall, five theories/models in health education and health promotion were used in selected studies as follow: Health Belief Model (HBM) (*9/14, 64%*) (19-22, 24-28), theory of extended parallel process model (EPPM) (*1/14, 7 %*) (31), theory; Trans theoretical Model (TTM) (3/14, 21%) (23, 26, 30), Integrated Behavioral Model (IBM) (*1/14, 7%*) (32), Social Cognitive Theory (SCT) (*1/14, 7%)* (29)(Table 2). The definition for each Theory or Model is summarized in Table 4. The systematic review showed that HBM was the most common model used to assess the effect of theories and models on self-care behaviors in Breast Cancer. A total of 14 studies were included in this review; of them, 11 studies (*78. 5%*) showed that educational intervention based on the health education models and theories improved self-care behaviors and self-management behaviors in Breast Cancer (19-28, 32).

**Table 4:** Characteristics of the health education and promotion theories/models

| Models or theories | Constructs |
|---|---|
| Health Belief Model<br>**HBM (44)** | **Perceived susceptibility**: Belief about the chances of getting a condition or disease or experiencing a risk<br>**Perceived severity**: Belief about how serious a condition and its sequelae are<br>**Perceived benefit:** Belief in the efficacy of the advised action to reduce the risk or seriousness of the impact<br>**Perceived barriers**: Beliefs about the tangible and psychological costs of the advised action<br>**Cues to action**: Strategies to activate "readiness" **Self-efficacy**: Confidence in one's ability to take action |
| Trans-Theoretical | **Per-contemplation:** No intention to take action within the next six months. |

| | |
|---|---|
| Model<br><br>**TTM (44)** | **Contemplation**: Intends to take action within the next six months<br>**Preparation:** Intends to take action within the next 30 days and has taken some behavioral steps in this direction.<br>**Action:** Changed overt behavior for less than six months<br>**Maintenance:** Changed overt behavior for more than six months<br>**Termination:** No temptation to relapse and 100% confidence |
| Integrated Behavioral Model<br><br>**IMB (45)** | **Health behavior information:** Information consists of specific facts about health promotion and relevant heuristics<br>**Health behavior motivation consists of** personal and social motivation that affects the performance of health-related behavior.<br>**Health behavioral skills:** A Serious determinant of whether well-informed/ motivated people will be able to effectively act on health promotion behaviors. |
| Social Cognitive Theory<br><br>**SCT (46)** | Knowledge, situational perception, outcome expectations/ expectancies, self-efficacy in overcoming impediments, environment, emotional coping, goal setting, or self-control |
| Extended parallel process model<br><br>**(EPPM) (47)** | It describes the interaction between emotion (perceived threat) and rationality (perceived efficacy) in behavioral decision making.<br>**Fear:** Internal adverse emotional reaction comprising psychological and physiological dimensions elicited by a severe and personally relevant threat**.**<br>**Perceived threat:** Cognitions about danger or harm that exists in an environment. Perceived threat comprises two underlying dimensions: severity and susceptibility**.**<br>**Perceived susceptibility:** Beliefs about one's risk of experiencing the threat.<br>**Perceived severity:** Beliefs concerning the consequences should a specified event occur.<br>**Efficacy:** Cognitions about the effectiveness, feasibility, and ease with which a recommended response impedes<br>or averts a threat. Contains two underlying dimensions: response efficacy and self-efficacy.<br>**Self-efficacy:** Beliefs about one's ability to perform the recommended response to avert the threat.<br>**Response efficacy:** Beliefs about the effectiveness of the recommended response in deterring or avoiding the threat.<br>**Danger control**: A cognitive process eliciting protection motivation that occurs when one believes she or he can effectively avert a significant and relevant threat through self-protective changes. When in danger , people think of strategies to avert a threat.<br>**Danger control responses:** Belief, attitude, intention, and behavior changes with a message's recommendations. |

## *HBM*

Among the studies included in this review, nine studies used the Health Belief Model (HBM) to improve breast cancer self-care behaviors. Kıssal et al. (19) aimed to examine the effect of an educational program based on the Health Belief Model (HBM) on practices of breast self-examination (BSE). They showed that knowledge about breast cancer and BSE skills increased after the educational interventions. They also showed that self-efficacy had the most potent, most substantial effect on promoting self-care behaviors compared to other constructs.

Masoudiyekt et al showed that before the intervention, the mean scores of knowledge and health beliefs in the two groups were similar in almost all subscales, and three months after the training intervention, the mean scores of knowledge, perceived susceptibility, perceived severity, causes to action, perceived benefits, and perceived self-efficacy were significantly higher in the intervention group(20). They also showed that self-efficacy had the strongest and most substantial effect on promoting self-care behaviors compared to other constructs.

Khiyali et al showed that the mean scores of knowledge, HBM constructs, and self-examination behavior in the experimental group were elevated compared to the control group after the intervention ($P < .001$) (21).

Torbaghan et al. (24) showed that there were significant changes in the training group, following educational intervention in the awareness construct and some constructs of the HBM including perceived susceptibility, perceived benefits, and perceived barriers, as well as in practice compared to the control group ($P < .05$). However, perceived barriers remained the only predictor in the model, such that for every unit increase in this variable, the behavior score increased by 18%.

Farma et al. (22) showed that the mean score awareness in the case group before and after education intervention has a significant difference ($P < .0001$): Susceptibility score ($P < .002$), self-efficacy, perceived severity, perceived benefits, perceived barriers ($P < .0001$). Behavior scores before and after intervention in the case group had a significant difference. However, in the control group, there was no significant difference before and after the

intervention.

Rezaeian et al. (25) showed that before the intervention, the mean scores of knowledge and health beliefs in the two groups were similar in almost all subscales except for perceived severity and health motivation. Four weeks after the educational intervention, the mean scores of knowledge, perceived susceptibility, perceived severity, health motivation, perceived benefits of mammography screening, and perceived self-efficacy regarding mammography were significantly higher in the intervention group.

Secginli et al. (27) showed that after the Breast Health Promotion (BHP) program, in terms of the BSE performance and BSE proficiency, the differences were significant between the two groups both at 3- and 6-month follow-ups (*p < .001*). Three months after the BHP program, women in the intervention group were over four times more likely to perform regular BSE than women in the control group (*OR= 4.21, 95% CI 1.98, 8.94).* At six months after the BHP program, women in the intervention group were over three times more likely to perform regular BSE than women in the control group (*OR= 3.42, 95% CI 1.50, 7.77*).

Deavenport et al. (28) showed that low-income women in the intervention group than woman in the control group had greater perceived benefits, *F(1, 208) = 3.10, p < .01)*, a greater net score of perceived benefits minus perceived barriers, *F(1, 208) = 5.25, p < .05)*, and greater self-efficacy, *F(1, 208) = 10.32, p < .01)*, and greater intentions to obtain mammograms, *F(1, 208) = 32.37, p < .001).* Intervention and control groups, however, did not differ on their perceptions of disease severity, susceptibility, and barriers to mammogram screening in the univariate analysis.

Self-efficacy was the strongest independent predictor of mammogram intention (β = .455). The results of correlation analysis showed that greater breast cancer risk was significantly related to both higher levels of education *(r = .199, p < .005)* and greater perceived susceptibility *(r = .195, p < .01).*

## *HBM and TTM*

Fathollahi-Dehkordi et al. (26) showed that three months after the intervention, screening practice was 52% in the interventional versus 18% in the control group (p <.001). Knowledge and all Health Belief Model (HBM) subscale scores showed significant main effects of time and time × group interaction (p < .001 for all). The main effect of group was significant for knowledge, perceived susceptibility, perceived benefits, and health motivation subscales. The effect of group factor was significantly related to knowledge score and perceived sensitivity, benefits, and health motivation subscales. Three months after the intervention, most women in the interventional group were in the action stage of CBE compared to the controls who continued to be in the contemplation stage (p <.001).

## *Extended parallel process model (EPPM)*

Zonouzy et al. (31) showed that, comparing outcome variables (attitude, intention, and early breast cancer diagnosis) at baseline and follow-up assessments, the intervention group showed significant improvements in attitude (p = .01) and intention (p = .001). However, no significant improvement was observed for early breast cancer diagnosis (*P =.78*). The control group did not show any changes.

## *Theory: Transtheoretical Model (TTM)*

Ghahremani et al. (23) reported significantly greater improvements in the intervention group than in the control group for mean scores on all Transtheoretical Model (TTM) constructs (stages of change, self-efficacy, decisional balance, and processes of change) and for BSE behavior (*p <.001*).

Scruggs et al. (30) showed that women in the intervention group had significantly higher perceived self-efficacy than women in the standard care group (*F(1, 45) = 9.55, p .003*).

Also, the intervention group showed a significantly greater increase in the use of self-liberation, counterconditioning, and reinforcement management processes than the standard care group (p=.011). The mean (numerical) stage of change score was significantly higher in the intervention group (between action and maintenance, M= 4.3) than in the standard care group (between preparation and action, M= 3.6) (*p=.024*).

## *Integrated Behavioral Model (IBM)*

Ghaffari et al. (32) reported statistically significant differences across the three assessment time points (before, immediately after, and 2 months post-intervention) in scores for knowledge, perceived susceptibility, perceived severity, perceived benefits of BSE, perceived barriers to BSE, self-efficacy, perceived barriers to mammography, and subjective norms *(p < .001)*. However, no significant change was observed for perceived benefits of mammography *(p = .083).* Furthermore, regression analyses indicated that self-efficacy was the

strongest predictor of self-care behaviors among all examined constructs.

### *Social Cognitive Theory (SCT)*

Hatchett et al. (29) reported a significant group-by-time interaction for total days of exercise at 12 weeks, $F(1, 72) = 20.02$, $p < .001$, $\eta_p^2 = .22$. The intervention group showed significantly greater increases than the control group in the mean number of days per week of moderate- and vigorous-intensity exercise at both 6 and 12 weeks (*p < .001*). Specifically, group differences were significant for moderate-intensity exercise at 12 weeks and for vigorous-intensity exercise at both 6 and 12 weeks (*p < .001* for all comparisons).

### *Meta-analysis*

Of the 14 studies included in the systematic review, seven studies (providing data on 1,173 women) met the inclusion criteria for meta-analysis (19-32). Overall, the meta-analysis for intervention based on health education theory shows a positive effect across the HBM, IBM, and TTM models, indicating that the interventions increase women's engagement and knowledge in self-examination and self-management behaviors to prevent breast cancer (19-28, 30, 32). However, the pooled effect of the intervention based on health education theory was not significant. The reported pooled effect estimates for HBM, IBM, and TTM were 6.71(*95% CI: 6.59–6.82*), 7.00 (*95% CI: 5.86–8.14*), and -0.43 (95% CI: -0.72–0.14), respectively (Figures 2 and 3). Considerable heterogeneity was observed across the models ($I^2$ = *89%*), and visual inspection of the funnel plots suggested asymmetry (Figures 4 and 5). These results indicate that the meta-analysis may lack sufficient statistical power to detect the true effect of the intervention programs, due to the limited number of studies available for each theoretical model. Individual studies showed that Rezaiean's ES (Effect Size) (25) was a significant outlier compared to the other studies. This provided evidence that Rezaiean's studies on the women population might increase the overall ES of the intervention-designed studies.

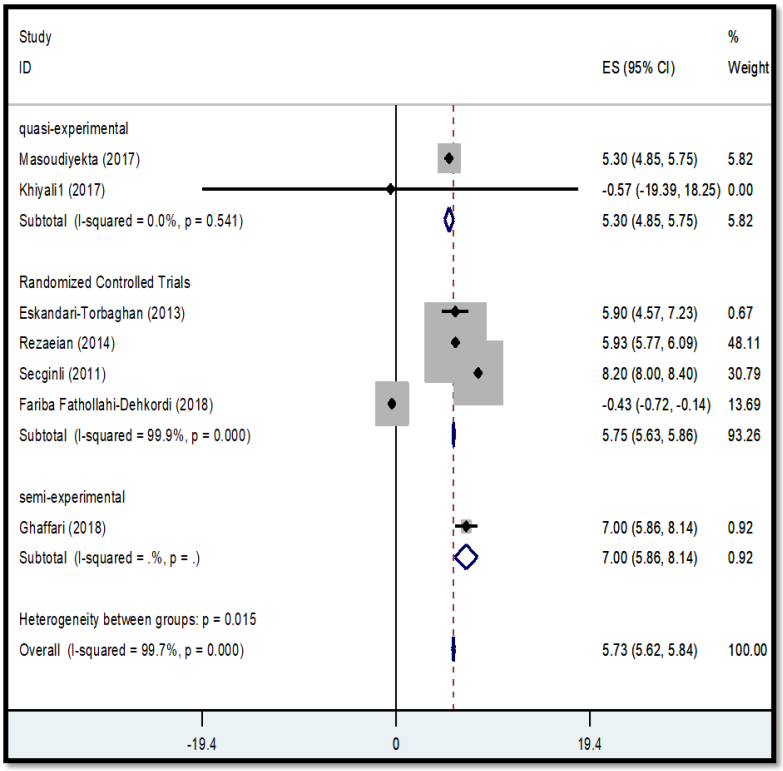


**Figure 2:** Forest plot for the effect of intervention on knowledge

The I2 showed significant heterogeneity for the models, and the funnel plot shows explicit gaps (Figures 4 - 5). These results indicated that the meta-analysis might lack sufficient power to assess the

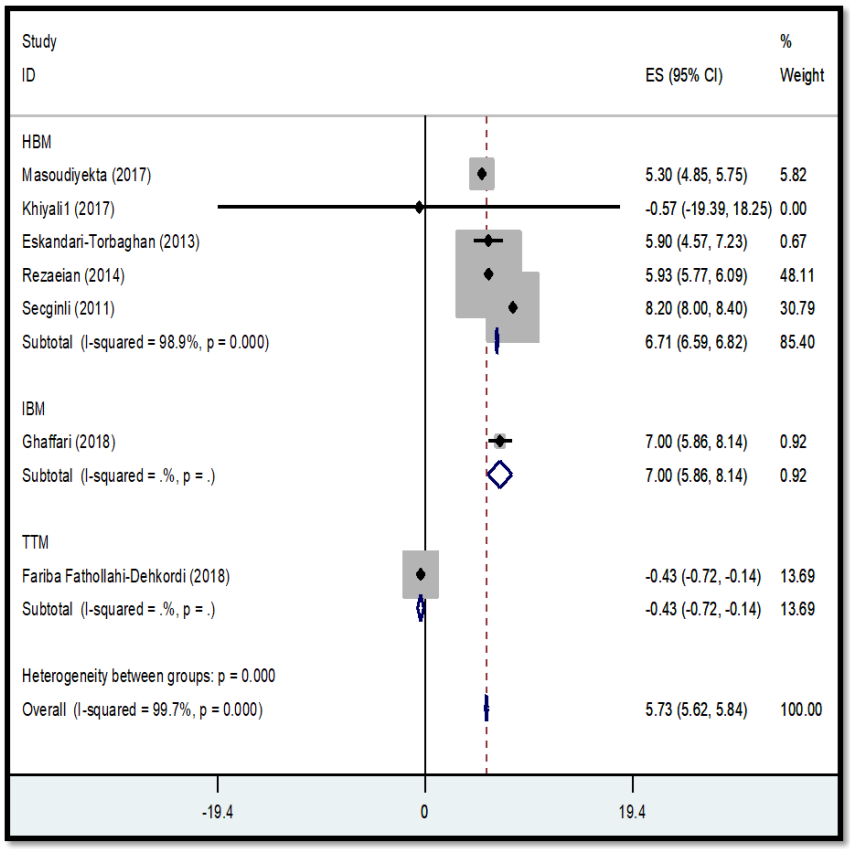


**Figure 3:** Forest plot for the effect of intervention on BSE behavior

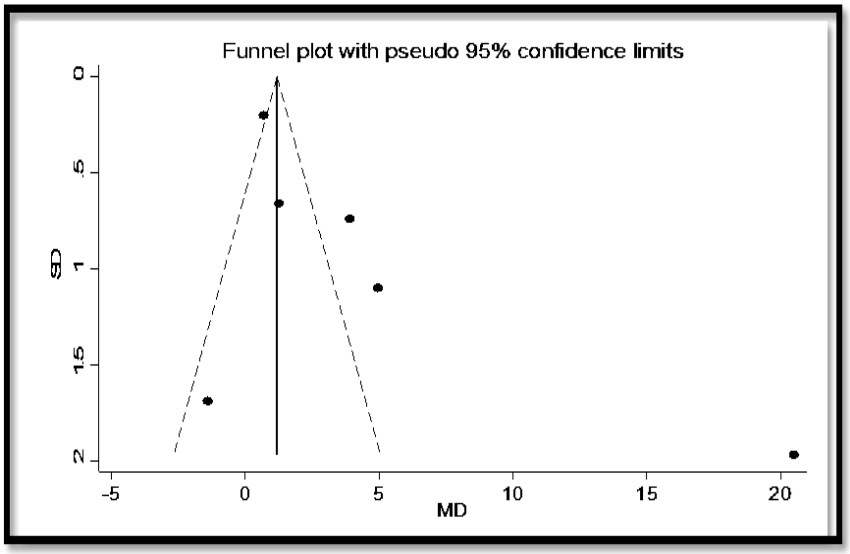


**Figure 4:** Funnel plot for intervention to improve BSE behavior

effect of the intervention programs because of the low number of studies for each health education model and theory. Individual studies showed that Rezaiean's ES (Effect Size) (30) was a significant outlier compared to the other studies. This provided evidence that Rezaiean's studies on the women population might increase the overall ES of the intervention-designed studies.

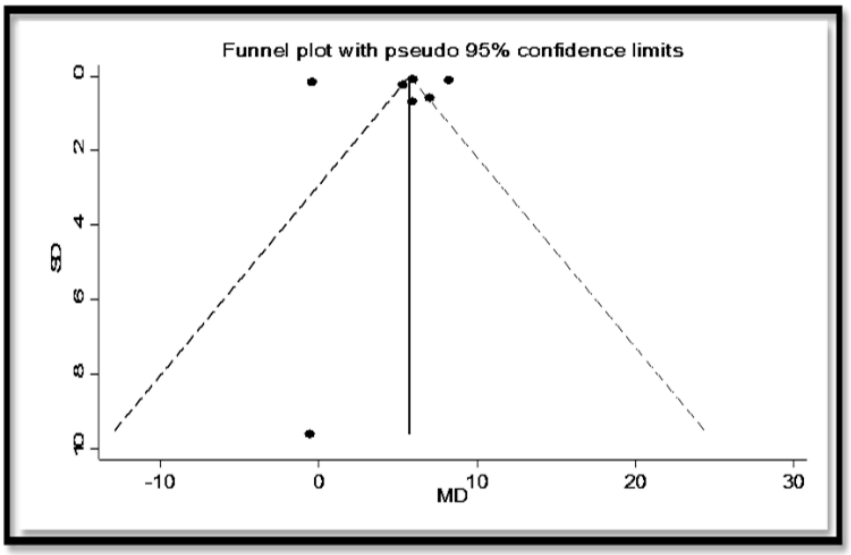


**Figure 5:** Funnel plot for intervention to improve knowledge

## Discussion

In this study, the main research questions were to collect evidence on the effect of educational intervention based on the health education and promotion theories and model on the improvement of self-management behaviors and self-examination skills. Studies included in the systematic review indicated that educational interventions grounded in health education and promotion theories and models incorporate key constructs that help improve breast self-examination (BSE) skills and breast cancer awareness, thereby empowering women to recognize and adopt effective self-care and self-management behaviors (19, 21, 25). Likewise, the meta-analysis provides strong evidence that educational interventions grounded in health education and promotion theories and models play a critical role in improving self-examination and self-management behaviors. However, given the methodological diversity of the included studies, small sample sizes, and a limited number of studies per theoretical model, these findings should be interpreted with caution. Therefore, future longitudinal, theory-driven intervention studies with larger, representative samples are essential to confirm these effects.

Our findings are further supported by several studies demonstrating that the regular implementation of educational interventions (grounded in health education and promotion theories and models) leads to significant improvements in women's attitudes and breast self-examination (BSE) skills, particularly when self-examination techniques are explicitly taught (33). Our results indicate that self-efficacy regarding breast self-examination (BSE) (20,21) and perceived barriers to BSE (23, 25) are central constructs in promoting preventive self-management behaviors—particularly through enhanced health awareness and strengthened beliefs about breast cancer risk and the value of mammography screening. Studies included in this review indicate that at the first step of an educational program, women need education to increase their awareness about breast cancer predictive behaviors (22, 32). Several studies indicated that in the training program, women's perception of their susceptibility to breast cancer and the severity of the illness were associated with their awareness about illness (24, 25). This sensitivity refers to people's beliefs about breast cancer vulnerability. It was evidenced that for women who received the educational intervention, their perceived susceptibility of having breast cancer increased in comparison with the control group (22, 25). Our results showed a significant increase in the intervention group's mean scores of self-efficacy after the intervention compared to the control group. In the same line, Bandura and Adams stated that self-efficacy was among the most essential, critical prerequisites for changing behavior. They also reported that self-efficacy had a significant impact on health behaviors (28). Similarly, Jalilian et al. state that individuals with low self-efficacy were less likely to adopt new health behaviors (34). Previous studies also

disclosed a positive relationship between self-efficacy and BSE behavior (35, 36).

## Conclusion

The results of this study indicate that the application of various health education and health promotion models and theories can positively influence health behaviors. Depending on the study's objective, different theoretical frameworks may be selected accordingly. Given the impact of educational intervention based on educational models and theories and health promotion, in the field of breast cancer prevention and its lower cost than treatment, policymakers should provide measures to estimate the cost and benefit of interventions, they should policy change organizational structures, consider physical and social environmental policies, and use a multifaceted approach to improve breast cancer prevention behaviors. Since promoting Breast Cancer Screening (BCS) behaviors requires a positive attitude toward screening, future studies must place specific emphasis on improving health education intervention models through appropriate sampling and randomization, systematic follow-up, and adequate sample size. Addressing these recommendations could help develop well-designed interventions and enhance self-examination and self-management behaviors for breast cancer prevention.

## Abbreviation

BCS, breast cancer screening; BHP, breast health promotion; BSE, breast self-examination; CBE, clinical breast exam; EPPM, extended parallel process model; ES, effect size; HBM, health belief model; IBM, integrated behavioral model; PRISMA, preferred reporting items for systematic reviews; SCT, social cognitive theory; SMD, standardized mean difference; TTM, trans theoretical model.

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## Ethical Approval

This study was conducted after the approval and permission of Mashhad University of Medical Sciences.
Science Research Committee (991909) and was conducted with consideration of the Helsinki Declaration in all phases of the study. Confidential data treatment was guaranteed.
Written informed consent was obtained from the participants.

## Competing interests

The author (s) declare that they have no competing interests.

## Authors' contributions

FP and BT conducted quality appraisals and involved data collection; interpreted the data and drafted the manuscript; AO analyzed the data and conducted quality appraisals; and NP designed and implemented the project. All authors read and approved the final manuscript. The authors declare that they have no competing interests.

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