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Improving coping self-efficacy in breast cancer survivors: The effectiveness of a 12-week combined exercise program

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Abstract:

BACKGROUND: Breast cancer survivors experience challenges in coping with their diagnosis and treatment. Regular physical activity shows promise in improving their well-being. This study investigated the effectiveness of a tailored 12-week combined exercise program (aerobic, strength, and pilates) in enhancing coping self-efficacy, a key psychological factor that empowers survivors to manage these difficulties.

MATERIALS AND METHODS: A randomized controlled trial (RCT) enrolled 60 breast cancer survivors (stages I–III). Participants were assigned to either a control group maintaining daily activities or the intervention group participating in a supervised, group-based, 12-week progressive combined exercise program (three sessions per week, 60–70 minutes per session) incorporating aerobic exercise, localized endurance training, and pilates. Both groups completed the study (n = 28 intervention, n = 25 control). Coping self-efficacy was assessed using the validated Persian version of the Chesney questionnaire pre and postintervention, focusing on three dimensions: stopping unpleasant emotions and thoughts, problem-focused coping, and getting support from family and friends.

RESULTS: The combined exercise program yielded a significant improvement in overall coping self-efficacy scores in the intervention group compared to the control group ($P < 0.001$). Interestingly, the most pronounced effect was observed in the "getting support from family and friends" dimension ($P < 0.001$). While improvements were also noted in the "stopping unpleasant emotions and thoughts" ($P = 0.072$) and "problem-focused coping" ($P = 0.157$) dimensions, these did not reach statistical significance.

CONCLUSION: This study demonstrates that a 12-week combined exercise program effectively improves coping self-efficacy, particularly in the "getting support from family and friends" dimension, among breast cancer survivors. The program's cost-effectiveness, feasibility, and sustainability warrant further evaluation for potential integration into healthcare policy to enhance the psychological well-being of this population.

Keywords:

Breast neoplasms, coping mechanisms, exercise therapy, psychological well-being, self-efficacy, social support

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Introduction

Breast cancer stands as the most prevalent cancer among women worldwide, posing a significant challenge not only for patients themselves but also for their families and the healthcare system.[1,2] Although advancements in medicine have led to improved survival rates,[3] breast cancer survivors often face a multitude of physical, psychological, and social challenges that can significantly impact their

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quality of life.[4,5] Effective strategies to enhance coping abilities and promote well-being in this population are crucial.[6]

Regular physical activity has emerged as a powerful tool in addressing the multifaceted needs of breast cancer survivors.[4] Exercise has been shown to improve physical fitness, reduce fatigue, alleviate anxiety and depression, and enhance overall quality of life.[7-9] However, despite these documented benefits, physical activity levels among breast cancer survivors remain low.[10,11]

To address this critical gap, this study investigates the novel impact of a 12-week combined exercise program on coping self-efficacy in breast cancer survivors. Coping self-efficacy, a key psychological construct, refers to an individual's belief in their ability to manage and overcome cancer-related challenges and symptoms.[12,13] Strengthened coping self-efficacy equips breast cancer survivors to effectively manage the psychological stressors associated with diagnosis, treatment, and the ongoing challenges of survivorship.[14]

This study offers a novel and innovative approach to addressing the psychological needs of breast cancer survivors through a combined exercise program. The program incorporates aerobic, strength (Pilates), and localized endurance training, targeting various aspects of physical fitness relevant to this population. This comprehensive approach has the potential to yield a more profound and multifaceted impact on coping self-efficacy compared to traditional exercise interventions.

By demonstrating the effectiveness of a combined exercise program in enhancing coping self-efficacy in breast cancer survivors, this study's findings could significantly impact the field of exercise interventions and provide valuable evidence for integrating such programs into supportive care plans. This could lead to improved psychological well-being, enhanced quality of life, and reduced healthcare costs for breast cancer survivors. Furthermore, the findings have the potential to inform clinical practice, research directions, and policy decisions aimed at improving the well-being of breast cancer survivors.

To investigate the impact of a combined exercise program on coping self-efficacy in breast cancer survivors, we developed a conceptual framework [Figure 1] that integrates relevant theoretical concepts and hypothesized relationships.

Objectives

This study investigated the following:

1. Efficacy of Combined Exercise: To assess whether a 12-week combined exercise program can lead to improvements in coping self-efficacy among breast cancer survivors.
2. Specific Effects on Coping Dimensions: To identify which specific dimensions of coping self-efficacy (e.g., stopping unpleasant emotions, utilization of problem-focused coping strategies, and getting social support) are most significantly impacted by the intervention program.
3. Demographic Correlates: To explore potential associations between demographic characteristics (age, educational attainment, and marital status) and coping self-efficacy in breast cancer survivors.

Materials and Methods

Study design and setting

This study used a randomized controlled trial (RCT) design to evaluate the efficacy of a 12-week combined exercise program on coping self-efficacy among breast cancer survivors. The study was conducted at Khatam-al-Anbia Hospital in Behshahr, Iran.

Study participants and sampling

To ensure a representative sample of breast cancer survivors from Khatam-al-Anbia Hospital in Behshahr, Iran, the study used a systematic random sampling method. This method involved:

Identifying the sampling frame: The sampling frame was created by listing all eligible breast cancer survivors treated at Khatam-al-Anbia Hospital within the past year.

Determining the sample size: A power analysis was conducted to ensure adequate power to detect a medium effect size ($d = 0.5$) with an 80% power ($1-\beta = 0.8$) and a 5% significance level ($\alpha = 0.05$). The sample size was calculated using the following formula: $n = (Z_{1-\alpha/2} + Z_{1-\beta})^2 (\sigma_1^2+\sigma_2^2)/d^2$. Assuming equal variances in both groups, a total sample size of 50 participants (25 per group) was determined. To account for potential attrition, a recruitment target of 60 participants (30 per group) was established.

Selecting participants: Using a random number generator, every 10th eligible patient on the sampling frame was selected until the desired sample size was reached. This ensured that participants were chosen randomly and evenly distributed throughout the entire patient population.

Participants in the intervention group engaged in supervised exercise sessions at a designated gym facility, while those in the control group received standard care. A CONSORT flow diagram [Figure 2] details the participant enrollment process.

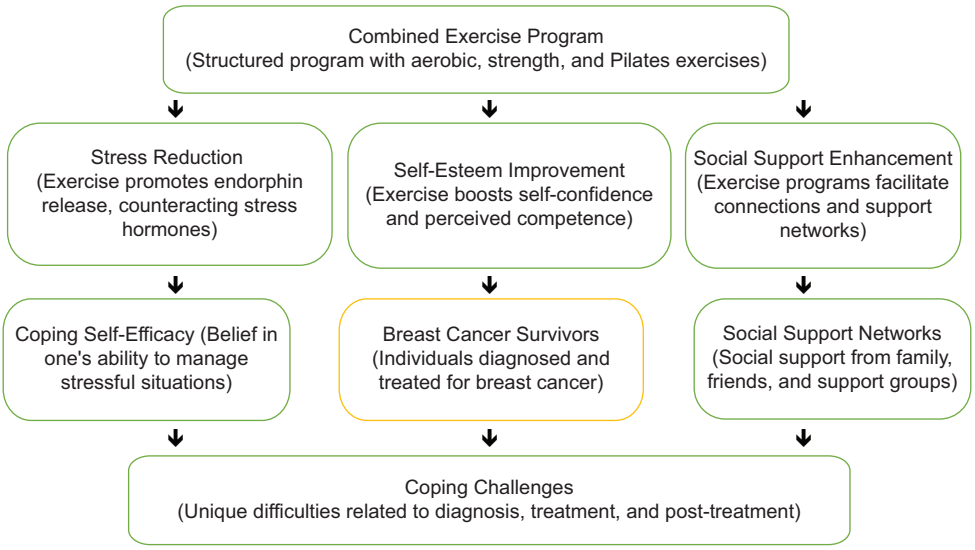

Figure 1: Conceptual framework diagram

Inclusion and exclusion criteria

This study recruited breast cancer survivors aged 30–75 years old, diagnosed with stages I–III, who had completed primary treatment (surgery, chemotherapy, radiotherapy) within the past 12 months. Participants were included if they were free of uncontrolled cardiovascular, respiratory, or metabolic diseases; were not currently using antidepressants or had no history of substance abuse; and demonstrated a commitment to study participation by providing written informed consent. In addition, smartphone ownership was a prerequisite for participation, enabling the delivery of the intervention via a mobile app (instructions, education, motivational messages) and facilitating real-time communication with participants (scheduling, reminders, feedback). Exclusion criteria included any medical limitations preventing participation in a supervised exercise program or unwillingness to provide written informed consent.

Randomization

Following written informed consent and oncologist confirmation of eligibility, participants were randomly assigned to either the intervention or control group using a centralized, computer-generated random sequence to ensure allocation concealment. Owing to the nature of the exercise intervention, blinding of participants and the oncologist was not possible.

- Intervention Group (Combined Exercise Program)
  The intervention group participated in a supervised, 12-week progressive combined exercise program (three sessions/week, 60–70 minutes/session) designed to improve coping self-efficacy in breast cancer survivors. The weekly program incorporated two aerobic exercise sessions (sessions 1 and 3) and one resistance training session (Pilates in session 2). Each session consisted of a structured three-part format: a 10-minute warm-up with light cardio and dynamic stretches, followed by a 50–60 minute main exercise component details sumarrized in Table 1, and concluding with a 10-minute cool-down emphasizing static stretches. The program included the following components:
  - *Aerobic Exercise:* The aerobic exercise component of the program involved brisk walking or jogging at an intensity of 50–70% of maximum heart rate (Tanaka formula) for 20–40 minutes per session. The duration and intensity of aerobic exercise were gradually increased over the 12-week program to ensure safety and effectiveness. Participants wore heart rate monitors throughout the sessions to track their progress and ensure they were exercising within the target heart rate zone.
  - *Localized Endurance Training:* Exercises like sit-ups (3 sets of 8–12 repetitions with 60–120 seconds rest), v-ups, and glute bridges following the same set and repetition structure. Modifications were offered to cater to different fitness levels and limitations. For example, planks could be performed on the knees or with forearms on the ground, while modified crunches could be done with a small pillow under the lower back.
  - *Strength Training (Pilates):* The second session each week focused on Pilates exercises incorporating resistance bands (light, medium, and heavy) and Swiss balls. Examples of exercises may include modified bridges with resistance bands, rows with light resistance bands, and seated leg press using a Swiss ball. The program used a progressive resistance scheme, with 3 sets of 8–11 repetitions and 60 seconds rest, gradually increasing resistance

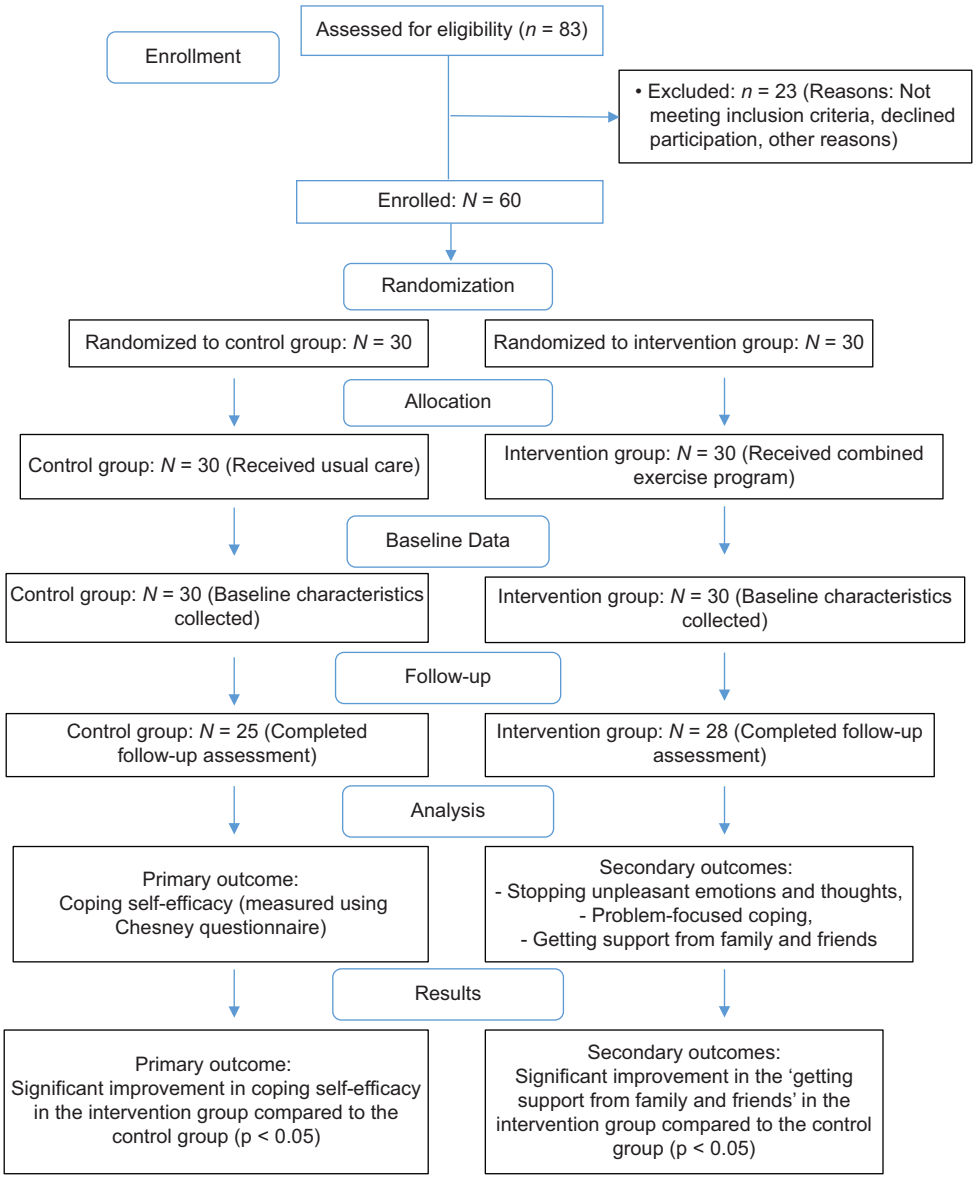

Figure 2: CONSORT flowchart for the randomized controlled trial investigating the impact of a combined exercise program on coping self-efficacy in breast cancer survivors

over the 12 weeks (e.g., using lighter bands for the first few weeks and progressing to heavier bands).

Intervention delivery and supervision

All exercise sessions were supervised by a certified exercise trainer who provided instruction on exercise techniques, monitored participants' exercise form and adherence, and offered motivation and support throughout the program. To ensure fidelity to the intervention protocol, the trainer used a combination of strategies including egular heart rate monitoring during aerobic sessions, observation of exercise form, and review of participant exercise logs to track progress and adherence.

- Control group:
  Participants maintained their usual activities and received educational pamphlets on standard breast cancer care. The exercise program was offered to them after the 12-week study period.

Data collection tools and techniques

- *Data Collection*
  At baseline, participants in both groups completed questionnaires to gather information on:
  Demographics: Age, body mass index (BMI), education, marital status, presence of children, residence, occupation, income, and insurance status.
  Medical History: Details of participants' breast cancer diagnosis (stage, etc.).
  Coping Self-Efficacy: The validated Persian version of the Chesney Questionnaire (26 items) assessed participants' abilities to manage unpleasant emotions and thoughts, employ problem-focused coping strategies, and seek support from friends and family.

Table 1: Summary of exercise progression schedule for breast cancer survivors (weeks 1, 5, and 12)

Week	Sessions	Warm-up	Main exercises	Cool-down
1	1-3	5 minutes walking, 5 minutes stretching	20 minutes of aerobic exercise. Movement chains (4 simple movements): Rhythmic: Easy step, V-up, Mambo, Grapevine, (Perform each movement 8 times consecutively, and then repeat the entire chain for a total of 15-20 minutes.) Floor exercises: Sit-up, V-up sit-up, Glute bridge, (3 sets of 8 repetitions with 10 seconds rest between sets and 60 seconds rest between exercises.)	10 minutes cool-down, 5 minutes stretching
5	1 and 2	10 minutes warm-up	30-35 minutes: Combined Aerobic and Floor Exercises Movement chains (4 simple movements): Rhythmic: Easy step, V-up, Mambo, Grapevine, (Perform each movement 8 times consecutively, and then repeat the entire chain for a total of 20-25 minutes.) Floor exercises (strength training): Sit-up, V-up sit-up, V-up sit-up left/right, Glute bridge, (3 sets of 8 repetitions, 10 seconds rest between sets, and 60-120 seconds rest between exercises.)	10 minutes cool-down
	3		Band Exercises (Resistance Training): Shoulder: lateral flexion with band, flexion and abduction with band, flexion/extension with band left/right, lateral flexion with band. Core and Upper Body: Squat with shoulder lateral flexion with band, Arm abduction/adduction with band left/right, Arm flexion/extension with band. Band leg exercises: Lower Body: Leg abduction with band right/left, Squat/Japanese salute with band, Leg extension on all fours with band right/left, and Leg adduction on all fours with band right/left, Front squat with band. Ball floor exercises: Swiss ball exercises: Half sit-up, V-up with long leg, (3 sets of 8 repetitions, 10 seconds rest between sets, and 60 seconds rest between exercises.)	
12	1 and 2	10 minutes warm-up	40 Minutes of Main Exercises: Movement chains (4 simple exercises, 30 Minutes.) Rhythmic: Easy step, V-up, Mambo, Grapevine, (Perform each movement 8 times consecutively, and then repeat the entire chain for a total of 30 minutes.) Floor exercises (10 Minutes): Sit-up, V-up sit-up, V-up sit-up left/right, Glute bridge, (3 sets of 12 repetitions, 10 seconds rest between sets, and 60 seconds rest between exercises.)	10 minutes cool-down
	3		Band Exercises (Resistance Training - Upper Body) - 15 Minutes: Shoulder lateral flexion with band, Shoulder flexion and abduction with band, Shoulder flexion/extension with band left/right, Shoulder lateral flexion with band, Squat with shoulder lateral flexion with band, Arm abduction/adduction with band left/right, and Arm flexion/extension with band. Band Exercises (Resistance Training - Lower Body & Core) - 15 Minutes: Squat/Leg abduction and arm adduction with band right/left, Squat/Japanese salute with band, Leg abduction and arm adduction with band right/left, Advanced leg extension on all fours with band right/left, Leg adduction in swimmer's position with bent knee with band right/left. Ball Floor Exercises (Core & Stability) - 10 Minutes: Half sit-up on Swiss ball, V-up with long leg on Swiss ball, Plank on Swiss ball, (3 sets of 12 repetitions, 10 seconds rest between sets, and 60 seconds rest between exercises.)	

- *Data Analysis*

  Data were analyzed using SPSS software (version 20). Baseline characteristics were compared between groups using Chi-square tests. Normality of data distribution was assessed using the Kolmogorov–Smirnov test. One-sample t-tests assessed changes within each group. Analysis of variance (ANOVA) examined intervention effects on pre and postintervention scores in both groups. Analysis of covariance (ANCOVA) controlled for confounding variables when examining intervention effects on pre and postintervention scores. The significance level was set at $\alpha = 0.05$ for all tests.

Ethical considerations

This randomized controlled trial used a before-and-after design and was conducted at Khatam-al-Anbia Hospital in Behshahr, Iran. The study received ethical

approval from the Ethics Committee of Islamic Azad University (ethical code IR.IAU.NAJAFABAD.REC.1402.199) and was registered with the Clinical Trials Registration Organization of Iran (registration code IRCT20230919059471N1).

Results

Baseline characteristics

A total of 60 breast cancer survivors were initially enrolled in the study, with 30 participants assigned to each group. However, due to attrition, the final sample size consisted of 28 participants in the intervention group and 25 participants in the control group. The demographic and medical history characteristics of these participants are summarized in Table 2. The participants' ages ranged from 35 to 74 years, and their BMIs varied. Most were married with children, had at least a high school education, and resided in urban areas. Medical history included lumpectomy/mastectomy, chemotherapy, and radiotherapy.

There were no significant between-group differences in age, BMI, education level, marital status, having children, residence, employment, income, insurance, time since diagnosis, or reported side effects (all $P > 0.05$). However, cancer stage ($P = 0.033$) and type of surgery ($P = 0.019$) differed significantly between the groups.

In the intervention group, most participants had simple total mastectomy (13, 46.4%) or nipple-sparing mastectomy (6, 21.4%). Conversely, the control group had more nipple-sparing mastectomies (8, 32%) and lumpectomies (7, 28%).

Normality of data

The Kolmogorov–Smirnov test was used to assess the normality of coping self-efficacy scores in both the intervention and control groups [Table 3]. The results confirmed normal distributions in both groups ($P > 0.05$). This finding satisfies the assumptions for using parametric statistical tests, such as one-sample t-tests, independent t-tests, and ANOVAs, to analyze the intervention's effect on coping self-efficacy.

- **Primary outcome: Coping self-efficacy**
  Coping self-efficacy scores improved significantly in both the intervention and control groups following the intervention [Table 4]. The intervention group, however, demonstrated a larger increase. Their mean score rose from 158.11 (SD = 14.01) at baseline to 183.81 (SD = 31.69) after 12 weeks ($P = 0.0001$*). Similarly, the control group showed a significant

Table 2: Demographic and medical history characteristics of intervention and control groups

Variable	Level	Intervention group (*n*=28)	Control group (*n*=25)	Chi-square test		
				Value	df	*P*
Employment status	Employed	2 (7.1%)	1 (4%)	0.62	1	0.244
	Unemployed	26 (92.9%)	24 (96%)			
Income (million IRR)	<100	21 (75%)	8 (32%)	2.4	2	0.207
	100-190	7 (25%)	15 (60%)			
	200-290	0 (0.0%)	2 (8%)			
Insurance status	Social Security	9 (32.1%)	7 (28%)	2.14	2	0.543
	Health Insurance	10 (35.7%)	6 (24%)			
	Other insurance	8 (28.6%)	9 (36%)			
	Complementary insurance	1 (3.6%)	3 (12%)			
Cancer stage	Stage 1	1 (3.6%)	14 (56%)	8.96	3	0.033*
	Stage 2	6 (21.4%)	10 (40%)			
	Stage 3	21 (75%)	1 (4%)			
Time from diagnosis to study enrollment	1 to 3 months	0 (0.0%)	1 (4%)	2.43	3	0.467
	4-6 months	17 (60.7%)	15 (60%)			
	7-12 months	11 (39.3%)	9 (36%)			
Type of surgery	Radical mastectomy	1 (3.6%)	5 (20%)	11.84	5	0.019*
	Modified radical mastectomy	4 (14.3%)	3 (12%)			
	Simple total mastectomy	13 (46.4%)	2 (8%)			
	Nipple-sparing mastectomy	6 (21.4%)	8 (32%)			
	Lumpectomy	4 (14.3%)	7 (28%)			
Treatments	Chemotherapy	14 (55%)	17 (68%)	2.01	4	0.570
	Radiotherapy	5 (17.9%)	2 (8%)			
	Chemotherapy and radiotherapy	6 (21.4%)	4 (16%)			
	Hormone therapy	3 (10.7%)	2 (8%)			
Side effects	Yes	18 (64.3%)	15 (60%)	0.11	1	0.748
	No	10 (35.7%)	10 (40%)			

*P<0.05

increase, with scores rising from 154.72 (SD = 14.33) to 163.56 (SD = 17.01) (P = 0.019*).

Although baseline scores were not statistically different between the groups (P = 0.389), a significant difference emerged in postintervention scores (P = 0.006*). This suggests that although both groups improved their coping self-efficacy, the combined exercise program in the intervention group led to a greater enhancement compared to the control group receiving standard care.

ANCOVA revealed a significant difference in coping self-efficacy scores between the intervention and control groups after 12 weeks (F = 6.496, P = 0.014, η2 = 0.117). The intervention group showed a larger increase in coping self-efficacy compared to the control group [Table 5]. This indicates that the combined exercise program had a positive effect on improving coping self-efficacy in breast cancer survivors.

Table 3: Normality Assessment of Coping Self-Efficacy Scores using the Kolmogorov–Smirnov Test

Variable	Stage	Kolmogorov–Smirnov test statistic	P
Coping self-efficacy	Preintervention	0.09	0.200
	Postintervention	0.06	0.200

*P<0.05

Secondary outcomes: Dimension-specific coping self-efficacy

We further analyzed the effect of the intervention on the three dimensions of coping self-efficacy: "stopping unpleasant emotions and thoughts," "problem-focused coping," and "getting support from friends and family."

- **Secondary outcome 1: Stopping unpleasant emotions and thoughts**

  The intervention group demonstrated a significant increase in mean scores for the "stopping unpleasant emotions and thoughts" dimension compared to the control group, which showed no significant change [Table 4]. At baseline, the intervention group's mean score was 87.66 (SD = 5.05) compared to 80.72 (SD = 8.48) for the control group (P = 0.001*). After 12 weeks, the intervention group's score rose to 92.42 (SD = 13.62), while the control group's score remained relatively stable at 80.00 (SD = 9.16) (P = 0.001*).

  Within-group analysis revealed a trend toward improvement in the intervention group (P = 0.072), while the control group showed no significant change (P = 0.647). This suggests that the combined exercise program may have contributed to an enhanced ability to manage unpleasant emotions and thoughts among breast cancer survivors.

  ANCOVA revealed no significant difference in stopping unpleasant emotions and thoughts scores between the intervention and control groups after

Table 4: Changes in coping self-efficacy scores by group

Variable	Group	Preintervention Mean (SD)	Postintervention Mean (SD)	Change (Mean±SD)	Within-group P	Between-group P
Coping Self-Efficacy	Intervention	158.11 (14.01)	183.81 (31.69)	25.70 (17.68)	0.0001*	0.389 (pre)
	Control	154.72 (14.33)	163.56 (17.01)	8.84 (10.29)	0.019*	0.006* (post)
stopping unpleasant emotions and thoughts	Intervention	87.66 (5.05)	92.42 (13.62)	4.76 (14.89)	0.072	0.001* (pre)
	Control	80.72 (8.48)	80.00 (9.16)	-0.72 (6.54)	0.647	0.001* (post)
Problem-Focused Coping	Intervention	56.51 (8.93)	62.44 (14.74)	5.93 (11.42)	0.157	0.015* (pre)
	Control	50.42 (8.18)	50.00 (9.30)	-0.42 (6.56)	0.810	0.001* (post)
Getting Support from Friends and Family	Intervention	15.96 (7.73)	33.64 (7.41)	17.68 (10.54)	0.0001*	0.015* (pre)
	Control	29.24 (3.65)	32.76 (3.16)	3.52 (4.88)	0.0001*	0.001* (post)

*P<0.05

Table 5: ANCOVA results for the effect of intervention on dependent variable scores

Dependent variable	Source of variation	Mean squares	F	P	Effect size (η2)
Coping self-efficacy	Preintervention score	2711.535	4.377	0.042*	0.082
	Group	4024.325	6.496	0.014*	0.117
	Error	619.524	-	-	-
Stopping unpleasant emotions and thoughts	Preintervention score	720.928	6.147	0.017*	0.123
	Group	297.027	2.533	0.091	0.103
	Error	117.277	-	-	-
Problem-focused coping	Preintervention score	1069.318	8.306	0.006*	0.150
	Group	654.516	5.084	0.029*	0.098
	Error	128.737	-	-	-
**Getting support from friends and family	Group	10.294	0.305	0.583	0.006*
	Error	33.784	-	-	-

*P<0.05 **ANOVA results

12 weeks (F = 2.533, P = 0.091, η2 = 0.103). While the effect size (η2) suggests a possible small influence of the intervention (10.3% of variance explained), the P value indicates a lack of statistically significant difference [Table 5]. Further research may be needed to determine the effectiveness of exercise programs specifically targeting this aspect of coping.

- **Secondary outcome 2: Problem-focused coping**
  The intervention program showed a trend toward increased scores in the "problem-focused coping" dimension, with the mean score rising from 56.51 (SD = 8.93) at baseline to 62.44 (SD = 14.74) after 12 weeks, although this change was not statistically significant (P = 0.157) [Table 4]. However, this change was not statistically significant (P = 0.157). The control group experienced a slight decrease in mean score (from 50.42 to 50.00), which was also not statistically significant (P = 0.810).
  Independent t-tests revealed significant differences between the intervention and control groups in terms of preintervention scores (P = 0.015*) and postintervention scores (P = 0.001*) for the "problem-focused coping" dimension [Table 4]. This suggests baseline group differences and potential intervention effects, although further analysis with a larger sample size might be needed to confirm these findings for this specific dimension.
  ANCOVA analysis revealed a significant effect of the intervention on "problem-focused coping" scores (F = 5.084, P = 0.029, η2 = 0.098) [Table 5]. The intervention group demonstrated a significantly larger increase in mean "problem-focused coping" score compared to the control group after 12 weeks (intervention: 62.44, control: 50.00). The eta-squared value (η2 = 0.098) suggests that 9.8% of the variance in "problem-focused coping" scores can be attributed to the intervention. These findings indicate that the combined exercise program had a positive impact on improving problem-focused coping in breast cancer survivors.
- **Secondary outcome 3: Getting support from friends and family**
  In contrast to the findings for problem-focused coping, both the intervention and control groups experienced significant increases in mean scores for the 'getting support from friends and family' dimension [Table 4]. The intervention group's score increased from 15.96 (SD = 7.73) at baseline to 33.64 (SD = 7.41) after 12 weeks (P = 0.0001*). Similarly, the control group showed a significant increase from 29.24 (SD = 3.65) to 32.76 (SD = 3.16) (P = 0.0001*).
  Interestingly, although there was a significant difference between the baseline scores of the two groups (P = 0.001*), indicating potentially lower perceived social support in the intervention group initially, the postintervention scores did not differ significantly (P = 0.583). This suggests that both groups benefitted from increased social support over time, potentially due to factors unrelated to the intervention program.
  ANOVA analysis revealed no statistically significant effect of the combined exercise intervention on scores for "getting support from friends and family" (F = 0.305, P = 0.583, η2 = 0.006*) [Table 5]. The effect size (η2 = 0.006) indicates a minimal influence of the intervention on this specific aspect of coping. These findings suggest that the intervention program did not significantly impact perceived social support from friends and family in breast cancer survivors.

Demographic moderation of intervention effects on coping self-efficacy

Independent t-tests and ANOVAs at pre and postintervention assessed potential moderation of intervention effects on coping self-efficacy by age, education, marital status, and employment. No significant interactions emerged (P > 0.05), suggesting a consistent intervention effect across all demographic subgroups of breast cancer survivors. Future studies with larger samples could explore alternative moderation analyses.

Discussion

This study examined the effectiveness of a 12-week combined exercise program (aerobic, strength, and Pilates) in enhancing coping self-efficacy in breast cancer survivors. The results yielded significant improvements in coping self-efficacy within the intervention group compared to the control group, supporting our hypothesis and aligning with the study's primary objective: evaluation of the intervention's effectiveness.

These findings resonate with those of a similar study examining the impact of a health belief model-based intervention on self-care behaviors in high-risk women for breast cancer.[5] Both studies contribute robust evidence for the efficacy of interventions in improving psychological outcomes in breast cancer survivors. Our findings add to the growing body of evidence highlighting the value of structured exercise interventions for enhancing psychological well-being in this population.[4,15,16] These studies, along with the present investigation, demonstrate the effectiveness of diverse interventions in improving psychological outcomes for breast cancer survivors. In addition, our work aligns with previous research highlighting the strong association between coping self-efficacy and positive outcomes in cancer patients.[10,17]

Our study uniquely investigates the impact of a combined exercise program on coping self-efficacy,

extending the scope of prior research that primarily focused on single exercise modalities (e.g., Salchow *et al*. (2021)).[18] This multifaceted approach aligns with the growing understanding of exercise's broader benefits for psychological well-being.

This study reinforces the value of incorporating exercise programs into supportive care for breast cancer survivors. By demonstrating a positive impact on coping self-efficacy, a crucial factor in managing cancer-related challenges and maintaining quality of life,[19-21] our findings support the integration of exercise interventions as an empowering tool for survivors.

The second objective examined which specific dimensions of coping self-efficacy were most impacted by the intervention. Specifically, the program led to significant improvements in the "getting support from family and friends" dimension of coping self-efficacy. This finding is consistent with the hypothesis that the program would enhance social support networks, a key factor in coping self-efficacy. Echoing the findings of Zhang *et al*. (2022),[22] our study revealed notable enhancements in self-efficacy, particularly in the domain of social support, represented by the "getting support from family and friends" subscale. This observation aligns with the growing body of evidence highlighting the positive impact of exercise interventions on social support networks among cancer survivors.[23]

The exact mechanisms through which the integrated exercise program enhanced coping self-efficacy are probably multifaceted. One potential explanation is that the group exercise structure promoted social support networks among participants. This is consistent with findings from previous studies,[13,22,24] indicating that social relationships can enhance coping skills. Potential mechanisms for this effect include enhanced self-esteem, reduced social anxiety, and improved communication skills, all of which could strengthen one's capacity to seek support.[13,17,25] These findings align with our observations and suggest broader applicability of exercise interventions for promoting social support networks in breast cancer survivors.

In addition, the exercise component itself may have contributed through stress reduction pathways linked to endorphin release and potential neuroplasticity benefits.[13,26] Integrating such interventions into cancer care offers a nonpharmacological approach to enhance coping abilities, potentially leading to overall well-being and quality of life improvement.[27]

Although no statistically significant demographic associations were found, future research with larger and more diverse samples can further explore this aspect. In addition, qualitative methods could delve deeper into the specific mechanisms underlying the intervention's effect, exploring participants' perspectives on how the program enhanced their coping self-efficacy. Investigating the program's effectiveness in diverse populations or with adaptations for home-based delivery would broaden its applicability.

Strengths and contributions

The present trial holds significant value for advancing knowledge on the effects of exercise on breast cancer survivor health. Its strengths include robust randomized controlled design, innovative intervention focused on coping self-efficacy, utilization of a combined exercise program, adequate sample size, homogenous participant group, well-defined intervention, multidimensional assessment of coping self-efficacy, validated outcome measures, consideration of limitations, and clear clinical implications.

Limitations and recommendation

- Limitations
  The baseline group differences in cancer stage and type of surgery are a limitation. While we statistically controlled for these factors, they might have subtly influenced participant responses. Future studies with larger sample sizes and more homogenous groups could mitigate this potential bias.
  The nonblinded design of this study, with participants aware of their group assignment (intervention vs. control), introduces the possibility of response bias. In addition, the generalizability of the findings might be limited due to the specific sample population and hospital setting. Future research could use a blinded design, include larger and more diverse samples, and investigate long-term effects to strengthen the study's limitations.
- Recommendations
  Despite these limitations, the study's findings have significant public health implications. The feasibility and effectiveness of the combined exercise program suggest its potential for integration into healthcare settings or community-based programs specifically designed for breast cancer survivors. Such programs could empower survivors to manage their condition more effectively, potentially improving their overall well-being and reducing healthcare utilization rates. Future research focused on cost-effectiveness analysis could further strengthen the case for wider implementation.

Clinical implications

Healthcare providers should consider incorporating the combined exercise program into treatment plans for breast cancer survivors. The program can be

implemented in healthcare settings or community-based programs. Exercise interventions can empower breast cancer survivors to manage their condition and improve their overall well-being. This study provides valuable evidence supporting the use of combined exercise programs to enhance coping self-efficacy in breast cancer survivors. Further research is warranted to refine the intervention and expand its reach to improve the lives of survivors.

Conclusion

This randomized controlled trial demonstrated the effectiveness of a combined exercise program in significantly improving coping self-efficacy, particularly regarding social support, among breast cancer survivors. The program's feasibility and potential for adaptation suggest its promise as a scalable intervention for enhancing psychological well-being in this population.

The study's findings offer valuable insights for healthcare policy considerations. Integrating combined exercise programs into treatment plans for breast cancer survivors could be a promising strategy for healthcare providers. In addition, allocating resources to support the development and implementation of community-based exercise programs specifically designed for breast cancer survivors could have a significant impact. Public health campaigns raising awareness about the benefits of exercise for both physical and mental health among survivors could further enhance program adoption.By considering these recommendations, healthcare systems and communities can potentially contribute to improved quality of life for breast cancer survivors through evidence-based interventions.

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Conflicts of interest

There are no conflicts of interest.

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