

Psychological, motivational, and physical effects of a supervised exercise program in women with breast cancer undergoing adjuvant treatment: a pilot intervention study

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Abstract

Background

This study examined the effects of a supervised physical exercise programme on physical, psychological, and motivational outcomes in women with breast cancer receiving adjuvant treatment.

Methods

Sixteen participants completed a structured intervention over several weeks, assessing changes in muscle strength, functional capacity, psychological well-being, motivation to exercise, and overall quality of life.

Results

The results showed significant improvements in physical parameters, including increased strength and functional performance, along with reductions in anxiety and depression levels. Participants also demonstrated increased intrinsic motivation to maintain regular exercise and reported positive and significant changes in their perception of quality of life and physical well-being.

Conclusion

These findings suggest that incorporating individualised exercise programmes during adjuvant therapy provides multidimensional benefits, supporting physical recovery, psychological well-being, and adherence to healthy behaviours.

Trial registration:

ClinicalTrials.gov NCT07843121 25/09/2026). Retrospectively registered.

1. Introduction

Cancer is one of the greatest challenges in global public health. According to the IARC, the most commonly diagnosed cancer is breast cancer, with 2.3 million cases annually (11.7%), followed by lung cancer (11.4%) and colorectal cancer (9.7%)¹. In Spain, the SEOM reported 36,000 cases of breast cancer in 2024, with the disease being most common among women aged 45 to 65¹.

Despite advances in diagnosis and treatment, many survivors experience chronic physical, physiological, and psychological sequelae that affect their quality of life²⁻⁴. Evidence shows that physical exercise provides benefits during and after treatment, improving quality of life, reducing fatigue and increasing strength and VO₂max⁵⁻⁷. Similar benefits are observed in menopausal women⁸ and in prostate cancer patients through strength-endurance programmes⁹.

However, few survivors meet physical activity recommendations due to lack of knowledge, fatigue, pain, time, and motivation¹⁰⁻¹². Support from family and friends, especially when it promotes autonomy, is essential for emotional well-being, as are factors such as self-esteem, body image, and type of surgical intervention¹³⁻¹⁶.

Motivation is key to adherence to exercise programmes¹⁷, and supervision increases participation and quality of life, even in patients with cardiovascular risk¹⁸. Recent reviews highlight the need to apply theoretical frameworks to understand motivational processes¹⁹. Most studies have used the theory of planned behaviour²⁰ and social cognitive theory^{21,22}, but few are based on Self-Determination Theory (SDT)^{23–25}.

According to SDT, motivation for physical activity depends on the satisfaction of three basic psychological needs (BPNs): competence, autonomy, and social relatedness. Their fulfilment generates self-determined motivation (intrinsic or identified regulated) associated with greater adherence and well-being, while their frustration leads to less healthy motivation and fewer benefits^{24,26}.

Despite growing attention to exercise, limitations in research persist, focusing mainly on post-treatment survivors and leaving a gap in the effects during adjuvant treatments, where women face a high burden of symptoms^{11,15,27}. Prospective research integrating more variables is needed to better understand the impact of interventions^{27,28}.

Therefore, this study aimed to analyse changes in psychological and motivational variables, including exercise regulation, BPN, and self-esteem, in women who had recently undergone breast cancer surgery and were undergoing adjuvant treatment, as well as to determine changes in quality of life, well-being, physical abilities, body composition, and exercise frequency.

2. Material and methods

2.1 Participants

This study was approved (94/2022) by the Bioethics and Biosafety Committee of the University of Extremadura, Spain, and followed the guidelines of the Declaration of Helsinki. All participants were treated in accordance with the ethical guidelines of the American Psychological Association regarding participant assent, parental/guardian consent, confidentiality, and anonymity. In addition, written informed consent was obtained from the participants. This study is reported in accordance with the CONSORT 2025 statement, extension to randomised pilot and feasibility trials.

The sample consisted of 16 women aged between 31 and 66 years ($M = 51.31$; $SD = 9.17$), with an average height of 160.62 cm ($SD = 6.07$) and average weight of 64.76 kg ($SD = 12.60$). The average BMI was 24.90 ($SD = 4.60$), very close to overweight. All had recently undergone breast cancer surgery at the San Pedro de Alc ntara Hospital in C ceres (Spain). All women participating in the study were receiving chemotherapy, radiotherapy and/or hormone therapy at the time of the study.

The participants were intentionally selected to participate in the study; however, selection for the experimental group was random.

The exclusion criteria for participation in the study were as follows: 1) having known cardiac abnormalities, such as unstable angina or recent myocardial infarction; 2) having any severe disability that could affect physical function, including severe arthritis; 3) having a current diagnosis of a severe psychiatric illness (those with minor psychiatric diagnoses will be eligible if they are well enough to participate); 4) being enrolled in a health behaviour trial or programme.

All participants completed the intervention.

2.2. Variables and measurement instruments

Basic psychological needs

Basic psychological needs were assessed using the *Basic Psychological Needs Satisfaction Scale* (BPNSS)²⁹, with validated Spanish adaptation³⁰. The instrument comprises 18 items distributed across three subdimensions—autonomy, competence, and relatedness. All items were rated on a 6-point Likert-type scale ranging from 1 to 6.

Types of Motivation: Motivation was assessed using the *Behavioural Regulation in Exercise Questionnaire–3* (BREQ-3)³¹, with validated Spanish adaptation³². The instrument consists of 23 items distributed across six regulatory dimensions: intrinsic, integrated, identified, introjected, external regulation, and demotivation. All items were rated on a 5-point Likert-type scale ranging from 0 to 4.

Self-esteem

Self-esteem was measured using the *Rosenberg Self-Esteem Scale*³³, with validated Spanish adaptation³⁴. The instrument consists of 10 unidimensional items—five positively worded and five negatively worded—rated on a 4-point Likert-type scale ranging from 1 to 4³⁵.

Quality of life: Quality of life was assessed using the Spanish version of the *Functional Assessment of Cancer Therapy–Breast plus Arm Morbidity* (FACT-B + 4)^{36,37}. The instrument comprises 42 items organized into five domains: physical well-being, social/family well-being, emotional well-being, functional well-being, and breast cancer– and upper-limb–specific concerns. Responses were provided on a Likert-type scale ranging from “not at all” to “very much.”

Perceived physical condition

Perceived physical condition was assessed using the *International Fitness Scale* (IFIS)³⁸. The scale comprises five items evaluating self-perceived fitness, each rated on a 5-point Likert-type scale ranging from 1 to 5.

Support for autonomy

Perceived autonomy support was measured using the *Perceived Support for Autonomy in Exercise Settings Scale* (PSAESS)³⁹, with validated Spanish adaptations⁴⁰. The scale includes 12 items assessing perceived autonomy support from family and friends. All items were rated on a 7-point Likert-type scale ranging from 1 to 7.

Physical variables: Body skinfold thickness was measured in millimetres using a skinfold caliper (Harpender Skinfold Caliper, HSB-B1, Baty/Quality Measurement Ltd, West Sussex, UK); waist and hip circumferences in centimetres using a tape measure (Holtain Ltd., Crosswell, Crymych, Pembrokeshire, United Kingdom); handgrip strength of both hands in kilograms using a hand-held dynamometer (Hand-Held Dynamometer 01165A, Lafayette Instrument Company, Lafayette, Indiana, USA); the 6-minute walk test were measured in metres; heart rate using a heart rate monitor (Polar Verity Sense, Polar Electro Oy, Kempele, Finland); and the Borg Scale⁴¹ to determine perceived fatigue.

Physical exercise frequency: measured (minutes) using a Fitbit watch (Fitbit Charge 4, Fitbit, Inc., Google, California, USA), that participants had to wear throughout the intervention.

2.3. Procedures

The principal investigator contacted the Department of Oncology and Gynaecology at San Pedro de Alcántara Hospital (Cáceres, Spain) to inform about the study and request permission for breast cancer patients to participate. The oncologist informed eligible patients, who completed the informed consent form and questionnaires under the

supervision of the investigator, ensuring anonymity and honest responses. The estimated time to complete the questionnaires was approximately 20 minutes.

2.4. Intervention

The intervention programme lasted 14 weeks, with two weekly 1-hour sessions led by a specialised professional, plus an additional hour of independent physical activity. The sessions were held in a safe space with padded tatami mats. Both psychological and physical aspects were addressed. For BPN, autonomy was encouraged through the choice of exercises, competence with clear instruction on the purpose and benefits of each activity, and social relationships through walks prior to the session and a WhatsApp group for cohesion and mutual support. In terms of physical activity, joint mobility, flexibility, aerobic exercise, strength, relaxation techniques, and breathing and posture education were addressed. An example of a weekly microcycle is included (Table 1).

Table 1
Example of the structure and content of a session.

SAMPLE SESSION
Warm-up (15 min)
■ Walking and sharing feelings: 5 minutes spent walking freely and discussing individual perceptions.
■ Joint mobility and manual lymphatic drainage: 10 minutes of specific mobility exercises for all joints, followed by movements aimed at activating the lymphatic system to prevent or reduce lymphoedema.
Main Part (35 min)
■ Dynamic work in pairs (10 minutes): Exercises performed simultaneously in pairs (e.g., lateral passes with medicine ball with hip rotation, overhead fitball passes, and opposite knee lifts by raising one foot onto a Bosu ball). Two sets of 12 repetitions were performed for each exercise.
■ Strength circuit (25 minutes): A circuit with 5 stations, including exercises such as wall push-ups, lunges, side leg and shoulder lifts, and balance on a Bosu ball with ball passing. Each exercise was performed in 3 sets with a maximum of 10 repetitions.
Cool-down (10 min)
■ Stretching and group debriefing: Stretching session combined with the opportunity to share feelings and experiences with the group, ending with a round of applause to acknowledge the effort made.

[Table 1]

2.5. Data análisis

The data were analysed using the Statistical Package for the Social Sciences (SPSS) version 21 (SPSS Inc., Chicago, Ill., United States). Normality was assessed using the Shapiro-Wilk test and, when this assumption was met, parametric tests were used. Means and standard deviations were calculated, and reliability analysis was performed using Cronbach's alpha (α), accepting values ≥ 0.70 , although lower values may be considered marginally acceptable when the number of items is small^{42,43}, and the Omega coefficient (ω), considered a more accurate index of internal consistency, with values between 0 and 1^{44,45}. Subsequently, the t-test for related samples was applied and the effect size was calculated according to Cohen⁴⁶, considering it small (< 0.10), medium ($0.10-0.30$) and large (> 0.50). The significance level was set at $p < 0.05$.

3. Results

3.1. Reliability analysis of questionnaires

The variables showed acceptable internal consistency (Table 2).

Table 2
Reliability Analysis of Questionnaires

Questionnaire/Factor	Original Items	Cronbach's alpha (Pre)	Cronbach's alpha (Post)	Omega (Pre)	Omega (Post)
BREQ-3					
Intrinsic Regulation	4, 12, 18, 22	0.62	0.90	0.88	0.83
Integrated Regulation	5, 10, 15, 20	0.66	0.93	0.79	0.81
Identified Regulation	3, 9, 17	0.89	0.83	0.86	0.79
Introjected Regulation	2, 8, 16, 21	0.61	0.64	0.71	0.64
External Regulation.	1, 7, 13, 19	0.52	0.76	0.63	0.65
Demotivation	6, 11, 14, 23	0.82	0.73	0.77	0.79
BPNS					
Competence	1, 4, 7, 9, 11, 14	0.78	0.95	0.85	0.94
Autonomy	2, 5, 8, 12, 15, 17	0.85	0.90	0.86	0.75
Social Relationships	3, 6, 10, 13, 16, 18	0.91	0.79	0.91	0.64
QUALITY OF LIFE					
Physical Well-being	-1,- 2,- 3,- 4,- 5,- 6, -7	0.73	0.66	0.64	0.60
Social/Familiar Well-being	8, 9, 10, 11, 12, 13, 14	0.61	0.74	0.67	0.73
Emocional Well-being	-15, 16, -17, -18, -19, -20	0.73	0.78	0.62	0.74
Functional Well-being	21, 22, 23, 24, 25, 26, 27	0.70	0.75	0.69	0.86
Additional Concerns	28, 29, 30, -31, 32, 33, 34, 35, -36, Fact1.	0.72	0.71	0.71	0.85
Upper body	Fact3, Fact4, Fact5, Fact6	0.85	0.89	0.87	0.88
SELF-ESTEEM					
Positives	1, 2, 4, 6, 7	0.72	0.61	0.83	0.72
Negatives	3, 5, 8, 9, 10	0.84	0.74	0.86	0.92
PHYSICAL CONDITION	1, 2, 3, 4, 5	0.72	0.64	0.78	0.78
SUPPORT FOR AUTONOMY	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	0.92	0.80	0.94	0.91
<i>Note: Cronbach's alpha (α): It is considered that it should be equal to or greater than 0.70. For variables with a small number of items, values below 0.70 may be marginally acceptable (Hair et al., 1998). Omega coefficient (ω): Its range is between 0 and 1, where higher values indicate more reliable measurements.</i>					

[Table 2]

3.2. Changes in Psychological and Well-being Variables.

[Table 3]

Table 3

Descriptive values and results of the paired samples *t*-test for psychological and well-being variables before and after the intervention.

Variable	Mean (SD) Pre	Range Pre	Mean (SD) Post	Range Post	Mean Diff (SD) Pre - Post	Est. Error	CI 95%	t	p (bilateral)	Cohen's d
<i>Intrinsic R.</i>	3.75 (1.0)	2.33–5.00	4.17 (1.0)	1.67–5.00	–0.42 (0.9)	0.23	[–0.90; 0.07]	-1.83	0.08	0.41
<i>Integrated R.</i>	3.61 (0.9)	2.50–5.00	3.95 (1.1)	2.00–5.00	–0.34 (1)	0.25	[–0.88; 0.20]	-1.35	0.19	0.34
<i>Identified R.</i>	3.94 (1.3)*	1.00–5.00	4.63 (0.6)*	3.00–5.00	–0.69 (1.2)	0.3	[–1.33; –0.04]	-2.26	0.03*	0.66
<i>Introjected R.</i>	1.97 (0.9)	1.00–3.75	2.31 (0.9)	1.00–4.00	–0.34 (1)	0.26	[–0.90; 0.21]	-1.31	0.20	0.36
<i>Extern R.</i>	2.06 (1.0)	1.00–3.67	1.56 (0.8)	1.00–3.67	0.5 (1.3)	0.32	[–0.19; 1.19]	1.53	0.14	0.53
<i>Demotivation</i>	1.92 (1.3)*	1.00–5.00	1.19 (0.4)*	1.00–2.67	0.73 (1.4)	0.34	[0.00; 1.45]	2.14	0.04*	0.75
<i>Competence</i>	3.40 (0.8)*	1.83–5.00	3.89 (1.0)*	1.33–5.00	–0.49 (0.8)	0.2	[–0.91; –0.07]	-2.46	0.02*	0.52
<i>Autonomy</i>	4.00 (0.9)	2.50–5.00	3.85 (1.1)	1.33–5.00	0.15 (1.1)	0.26	[–0.41; 0.71]	0.55	0.58	0.14
<i>Social Relationships</i>	3.66 (1.2)*	1.50–5.00	4.69 (0.5)*	3.25–5.00	–1.03 (1.2)	0.3	[–1.67; –0.39]	-3.41	0.00**	1.12
<i>Physical W.</i>	2.67 (1.2)*	1.00–4.67	3.75 (0.9)*	2.33–5.00	–1.08 (1.9)	0.47	[–2.08; –0.09]	-2.32	0.03*	1.05
<i>Social/Familiar W.</i>	4.77 (0.5)	3.33–5.00	4.75 (0.6)	2.67–5.00	0.02 (0.3)	0.08	[–0.16; 0.20]	0.25	0.80	0.04
<i>Emotional W.</i>	3.06 (1.2)	1.25–4.50	3.13 (1.1)	1.50–5.00	–0.06 (2.1)	0.53	[–1.20; 1.08]	-0.11	0.90	0.05
<i>Functional W.</i>	4.25 (0.6)	3.20–5.00	4.40 (0.6)	3.40–5.00	–0.15	0.18	[–0.54; 0.22]	-0.82	0.42	0.25

Note: Mean = arithmetic mean; SD = standard deviation; Range = minimum and maximum values observed; CI = 95% confidence interval. R.: Regulation; W.: Well-being; **p* < 0.05; ***p* < 0.01. All analyses were performed with 16 participants (*gl* = 15). The direction of change is interpreted as (Pre – Post)

Variable	Mean (SD) Pre	Range Pre	Mean (SD)Post	Range Post	Mean Diff (SD) Pre - Post	Est. Error	CI 95%	t	p (bilateral)	Cohen's d
					(0.7)		0.24]			
<i>Additional Concerns</i>	3.65 (0.8)*	2.00– 5.00	2.71 (0.7)*	1.00– 3.86	0.94 (0.7)	0.18	[0.56; 1.32]	5.24	0.00**	1.25
<i>Upper body</i>	2.52 (1.2)	1.00– 4.00	2.41 (1.2)	1.00– 5.00	0.11 (1.6)	0.4	[– 0.73; 0.95]	0.27	0.78	0.09
<i>Positive Self-esteem</i>	3.98 (1.1)*	2.00– 5.00	4.56 (0.5)*	3.67– 5.00	– 0.58 (1.1)	0.26	[– 1.15; – 0.02]	-2.20	0.04*	0.70
<i>Negative Self-esteem</i>	2.26 (1.1)*	1.00– 4.60	1.55 (0.8)*	1.00– 4.00	0.71 (1)	0.25	[0.17; 1.26]	2.79	0.01*	0.72
<i>Physical Condition</i>	2.56 (0.7)	1.00– 4.00	2.88 (0.6)	2.00– 3.67	– 0.31 (0.7)	0.16	[– 0.66; 0.03]	-1.92	0.07	0.46
<i>Support for Autonomy</i>	4.28 (0.7)	2.75– 5.00	4.55 (0.5)	3.50– 5.00	– 0.27 (0.7)	0.17	[– 0.63; 0.08]	-1.62	0.12	0.44
<i>Note: Mean = arithmetic mean; SD = standard deviation; Range = minimum and maximum values observed; CI = 95% confidence interval. R.: Regulation; W.: Well-being; *p < 0.05; **p < 0.01. All analyses were performed with 16 participants (gl = 15). The direction of change is interpreted as (Pre – Post)</i>										

3.3. Changes in Physical Tests and Body Composition

[Table 4]

Table 4

Descriptive values and results of the paired t-test for anthropometric, strength and body composition variables before and after the intervention.

Variable	Mean (SD) Pre	Mean (SD) Post	Mean Diff. (Pre – Post)	SD (dif.)	Est. Error	CI 95%	t	p (bilateral)	Cohen's d
Weist (cm)	86.81 (13.52)	86.50 (12.02)	0.31	2.73	0.68	[– 1.14;1.76]	0.45	0.65	0.02
Hip (cm)	99.56 (10.05)	99.81 (9.20)	–0.25	3.11	0.78	[– 1.91;1.41]	– 0.32	0.75	0.02
Right Handgrip 1 (kg)	22.43 (6.30)	23.67 (4.33)	–1.24	4.62	1.15	[– 3.71;1.22]	– 1.07	0.29	0.23
Right Handgrip 2 (kg)	22.20 (6.35)	23.63 (5.05)	–1.43	3.69	0.92	[– 3.39;0.54]	– 1.54	0.14	0.24
Left Handgrip 1 (kg)	19.30 (5.65)	21.68 (5.03)	–2.38	3.27	0.82	[–4.12;– 0.63]	– 2.90	0.01*	0.44
Left Handgrip 2 (kg)	20.08 (4.94)	21.41 (4.65)	–1.33	3.64	0.91	[– 3.27;0.61]	– 1.46	0.16	0.27
6 min walk (m)	531.04 (52.08)*	575.12 (57.42)*	– 44.08	41	10.25	[–65.92;– 22.24]	– 4.30	0.00**	0.8
Initial HR (lpm)	82.13 (7.70)	87.25 (11.19)	–5.13	9.8	2.45	[– 10.35;0.10]	– 2.09	0.05	0.53
Final HR (lpm)	118.81 (13.27)	116.00 (18.20)	2.81	15.5	3.87	[– 5.44;11.07]	0.72	0.47	0.17
Borg's Scale	3.59 (2.04)	3.13 (1.96)	0.47	2.05	0.51	[– 0.62;1.56]	0.91	0.37	0.22
Skinfolds (mm)									
Right Biceps	20.50 (8.30)	20.69 (7.52)	–0.19	1.22	0.31	[– 0.84;0.46]	– 0.61	0.54	0.02
Left Biceps	21.20 (8.19)	20.63 (7.53)	0	1.36	0.35	[– 0.76;0.76]	0	1	0.07
Right Triceps	28.06 (8.04)	27.94 (7.11)	0.13	1.78	0.45	[– 0.83;1.08]	0.28	0.78	0.01
Left Triceps	28.47 (8.42)	27.94 (7.23)	0	2.2	0.57	[– 1.22;1.22]	0	1	0.06
Right Subscapular	21.06 (7.19)*	22.00 (7.29)*	–0.94	1.48	0.37	[–1.73;– 0.15]	– 2.53	0.02*	0.12
Left Subscapular	21.06 (7.11)*	22.00 (7.29)*	–0.94	1.48	0.37	[–1.73;– 0.15]	– 2.53	0.02*	0.13

Note: Mean = arithmetic mean; SD = standard deviation; CI = 95% confidence interval. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. All analyses were performed with 16 participants ($gl = 15$). The direction of change is interpreted as (Pre – Post). Negative values indicate improvement (reduction in skinfolds or increase in performance). R = right, L = left.

Variable	Mean (SD) Pre	Mean (SD) Post	Mean Diff. (Pre – Post)	SD (dif.)	Est. Error	CI 95%	t	p (bilateral)	Cohen's d
Right Supraespal	24.38 (10.17)	25.00 (10.17)	–0.63	2.06	0.52	[–1.72;0.47]	–1.21	0.24	0.06
Left Supraespal	24.50 (10.22)	25.19 (10.05)	–0.69	1.89	0.47	[–1.69;0.32]	–1.45	0.16	0.06
Abdominal	28.00 (11.18)	28.50 (10.37)	–0.50	1.97	0.49	[–1.55;0.55]	–1.01	0.32	0.04
Right Quadriceps	44.81 (9.12)*	46.13 (8.37)*	–1.31	1.89	0.47	[–2.32;–0.31]	–2.78	0.01*	0.15
Left Quadriceps	44.81 (9.12)*	46.19 (8.39)*	–1.38	1.78	0.45	[–2.33;–0.42]	–3.08	0.00**	0.15
Right leg	29.31 (7.21)*	30.75 (7.00)*	–1.44	1.21	0.3	[–2.08;–0.79]	–4.75	0.00***	0.2
Left leg	29.31 (7.21)*	30.75 (7.00)*	–1.44	1.21	0.3	[–2.08;–0.79]	–4.75	0.00***	0.2

*Note: Mean = arithmetic mean; SD = standard deviation; CI = 95% confidence interval. *p < 0.05; **p < 0.01; ***p < 0.001. All analyses were performed with 16 participants (gl = 15). The direction of change is interpreted as (Pre – Post). Negative values indicate improvement (reduction in skinfolds or increase in performance). R = right, L = left.*

3.4. Changes in Physical Exercise Frequency

[Table 5]

Table 5

Descriptive values and results of the paired t-test for the variable of changes in physical exercise frequency before and after the intervention.

Exercise Variable	Mean (SD) Pre	Mean (SD) Post	Mean Diff.	SD Est Error	CI 95%	t	p (bilateral)	Cohen's d
Moderate	3.23 (2.45)	4.25 (4.84)	–1.03	1.39	[–3.98;1.93]	–0.74	0.47	0.26
Vigorous	0.69 (1.20)*	2.25 (2.05)*	–1.56	0.62	[–2.88;–0.24]	–2.52	0.02*	0.93
Very Vigorous	0.06 (0.25)	0.06 (0.25)	0	0.09	[–0.19;0.19]	0	1	0

*Notes: Mean = arithmetic mean; SD = standard deviation; CI = 95% confidence interval. *p < 0.05. The direction of change is interpreted as (Pre – Post). Negative values indicate an increase in exercise frequency after the intervention.*

4. Discussion

The findings of this study reinforce the importance of integrating physical exercise as part of adjuvant treatment in women with breast cancer. From the self-determination perspective, a significant increase in the identified regulation was observed, reflecting a greater appreciation of the benefits of exercise, along with improvements in two BPNs: competence and social relationships. These results demonstrate the success of the theoretical framework applied, promoting more self-determined motivation, greater adherence to exercise, and psychological well-being. Likewise, a

significant decrease in demotivation, additional concerns, and negative self-esteem was recorded, indicating an overall improvement in psychological well-being.

These findings coincide with Fu et al.⁴⁷, who observed that greater identified and intrinsic regulation is associated with greater physical activity and adherence, with competence being the main predictor of autonomous motivation; and with Jones et al.⁴⁸, who reported a robust positive relationship between autonomous motivation and physical activity. Although Behzadnia et al.⁴⁹ found improvements in all three BPNs with autonomy support, in this study only the BPNs of competence and social relationships improved. In relation to psychological well-being, a meta-analysis by Zhou et al.⁵⁰ showed favourable effects of exercise on fatigue, a key factor in quality of life⁵¹.

With regard to physical abilities, an 11.7% improvement was observed in left handgrip strength, which is lower than that reported in the literature (+ 21.9% to + 25.4%)^{52,53}. These differences are attributed to methodological aspects, as other studies used more comprehensive strength measurements. Given that handgrip strength assesses smaller muscles, its potential for percentage improvement may be lower. Even so, the results support the feasibility and benefit of the intervention in women with breast cancer undergoing adjuvant treatment.

In cardiorespiratory endurance, the distance covered in the 6-min walk test increased by 8.3%, in line with previous studies^{54,55}. Other studies reported improvements in VO_2max ⁵⁶, while some observed decreases during active chemotherapy⁵⁷. Furthermore, a Cochrane meta-analysis found no significant improvements, highlighting the heterogeneity of results⁵⁸. Taken together, these data suggest that the type and phase of treatment influence the cardiorespiratory response to exercise, with decreases even observed during intensive treatments due to factors such as cardiotoxicity. A significant reduction in skinfolds was also recorded, consistent with meta-analyses indicating that combined training improves body composition in this population⁵⁹. This is relevant, as muscle mass and adiposity can predict the severity of chemotherapy toxicities⁶⁰.

Likewise, a significant increase in vigorous exercise was observed, challenging the perception of barriers such as fatigue and demonstrating the ability to increase the intensity of physical activity during treatment. This finding is particularly relevant given the prevalence of fatigue and myths about intense exercise and its relationship to recurrence or lymphoedema¹¹. Health professionals should provide clear information, promote social support, and design tailored and flexible exercise programmes.

Among the limitations of the study are the absence of a control group, the small sample size ($N = 16$), and the lack of long-term follow-up, which limits causal inference and the generalisation of results^{9,61–63}. Future research should include controlled designs, larger samples, longitudinal follow-up, and explore different types, intensities, and modalities of exercise to optimise benefits at this critical stage of treatment.

5. Conclusion

This study analysed changes in psychological, motivational and physical variables in women who had recently undergone breast cancer surgery and were receiving adjuvant treatments. The results showed significant improvements in identified regulation, competence, social relationships, physical well-being and positive self-esteem, along with a decrease in demotivation, additional concerns and negative self-esteem, demonstrating a favourable impact on psychological well-being. Likewise, increases were observed in left handgrip strength, distance covered in the 6-minute walk test, and frequency of vigorous exercise, as well as a significant reduction in skinfold thickness.

Declarations

Abbreviations:

Not applicable

Ethics approval and consent to participate:

This study was approved (94/2022) by the Bioethics and Biosafety Committee of the University of Extremadura, Spain, and followed the guidelines of the Declaration of Helsinki. All participants were treated in accordance with the ethical guidelines of the American Psychological Association regarding participant assent, parental/guardian consent, confidentiality, and anonymity. In addition, written informed consent was obtained from the participants.

Consent for publication:

Not applicable

Funding:

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Author Contribution

RJC participated in the design of the study, contributed to data collection and data analysis, and to the manuscript writing; MLR participated in the design of the study, contributed to data collection and data analysis, and to the manuscript writing; SFA participated in the design of the study, contributed to data collection; AFC contributed to the manuscript writing. All authors have read and approved the final version of the manuscript and agree with the order of presentation of the authors.

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Data Availability

All data supporting the findings of this study are available within the paper and its Supplementary Information.

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