# Physical prehabilitation in patients with breast cancer: A systematic review

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**Abstract**

Introduction: In 2023, 35,000 new cases of breast cancer were diagnosed, becoming the first type of tumour diagnosed in Spain. This tumour and its treatments generate important changes in the patient's quality of life. Alterations in the range of motion, pain and both physical and psychological disability are some of the effects that breast cancer generates in patients. Physical prehabilitation could be an opportunity to prevent some of these adverse effects. Objective: The objective of this review was to analyse the changes in objective and subjective variables in patients with breast cancer who undergo prehabilitation compared to those who perform other interventions. Material and method: Eight databases were used for the bibliographic search of the present review. Following the selected inclusion and exclusion criteria, seven studies were analysed. The quality of these studies was assessed with the PEDro scale. The structural characteristics of the various articles were examined, as well as the objective (ROM and tumour markers) and subjective study variables (pain, physical and mental recovery, quality of life and psychological aspects. Results: A total of 1054 patients were analysed in the present review. All objective variables improved in the group that underwent physical prehabilitation. Subjective variables also improved in said group, although the improvement achieved in psychological aspects was not maintained over time. Conclusion**:** Physical prehabilitation is an interesting strategy to generate changes in breast cancer patients.

Keywords: preoperative, exercise, prehabilitation, breast cancer and breast neoplasm.

**Introduction**

Breast cancer is the second most frequently diagnosed type of tumour in the world (more than 12% of new diagnoses). In Spain, breast cancer was the most frequently diagnosed cancer in 2023 [1], with a total of 35,000 new cases [1]. However, despite the large number of new cases, survival has greatly increased as a result of treatment [1]. This tumour and oncological treatments generate adverse effects in women, producing changes in their quality of life [2]. Alterations in the range of motion (ROM) in the shoulder, pain and physical recovery are some adverse effects observed in breast cancer patients [2]. It is important to investigate strategies that can reduce the probability of developing these adverse effects.
Physical preparation of patients before oncological treatment may prevent some adverse effects. The period between cancer diagnosis and oncology-medical treatment is called prehabilitation [3]. Prehabilitation programmes prepare the patient nutritionally, emotionally and physically for cancer treatment [3]. The benefits of a prehabilitation programme may reduce the days of hospitalisation and the cost of health, and it may also improve post-treatment outcomes [3][4]. The aim of this systematic review was to analyse changes in objective and subjective variables in breast cancer patients of prehabilitation intervention versus other interventions.

## Methods

This systematic review followed the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidelines [5]. It was registered in PROSPERO International Register of Systematic Reviews CRD42024528201.

### Literature search

The literature research was performed in eight electronic databases: Pubmed, Web of Science, PEDro, NICE, Scopus, Medline Complete, CINAHL, and Embase. The following keywords were used: preoperative, exercise, prehabilitation, breast cancer and breast neoplasm. Keywords were combined using the Boolean operators "AND" and "OR". This literature search was conducted between April and June 2023 by two experienced researchers.

### Study Selection

Two blinded researchers performed the literature search and study selection. A third researcher, with more than ten years of experience in systematic reviews, selected those documents that generated conflict.
The inclusion criteria were: randomised control trials (RCTs); human studies; participants: women > 18 years of age; language: English, Spanish, French, Portuguese and/or Italian; and studies which analysed ROM, pain and physical recovery. The exclusion criteria were: participant: male patients and patients without breast cancer; and randomised control trials that did not explore prehabilitation programmes for patients with breast cancer before invasive surgery. Firstly, the titles were read, and then the researchers read the abstract and full-text documents. All duplicates and those that failed to meet the inclusion criteria were discarded.

### Study methodology

The structural characteristics of the selected articles were studied, along with the other principal variables.

The objective principal variable studied in this review was ROM and the subjective principal variables were pain and physical recovery. Other variables analysed in this systematic review were: tumour markers, disability, mental recovery, quality of life and psychological variables.

Data extraction

Two reviewers (ACV and MGS) examined data for suitability to be included in a meta-analysis. Some data could be analysed using Cochrane Collaboration Review Manager (RevMan) version 5.3 using random effects models. The I2 statistic was used to assess the heterogeneity of studies. The risk of bias was assessed independently by two reviewers (ACV and MGS), and a third reviewer (ADRJ) was available to settle any discrepancies. The measuring instrument employed was the Cochrane Collaboration risk of bias tool [6]. Risk of bias for each study was categorised as follows: low if all criteria were scored as low risk of bias, moderate if one or two criteria were scored as unclear or high risk of bias, and high if more than two criteria were scored as unclear or high risk of bias.

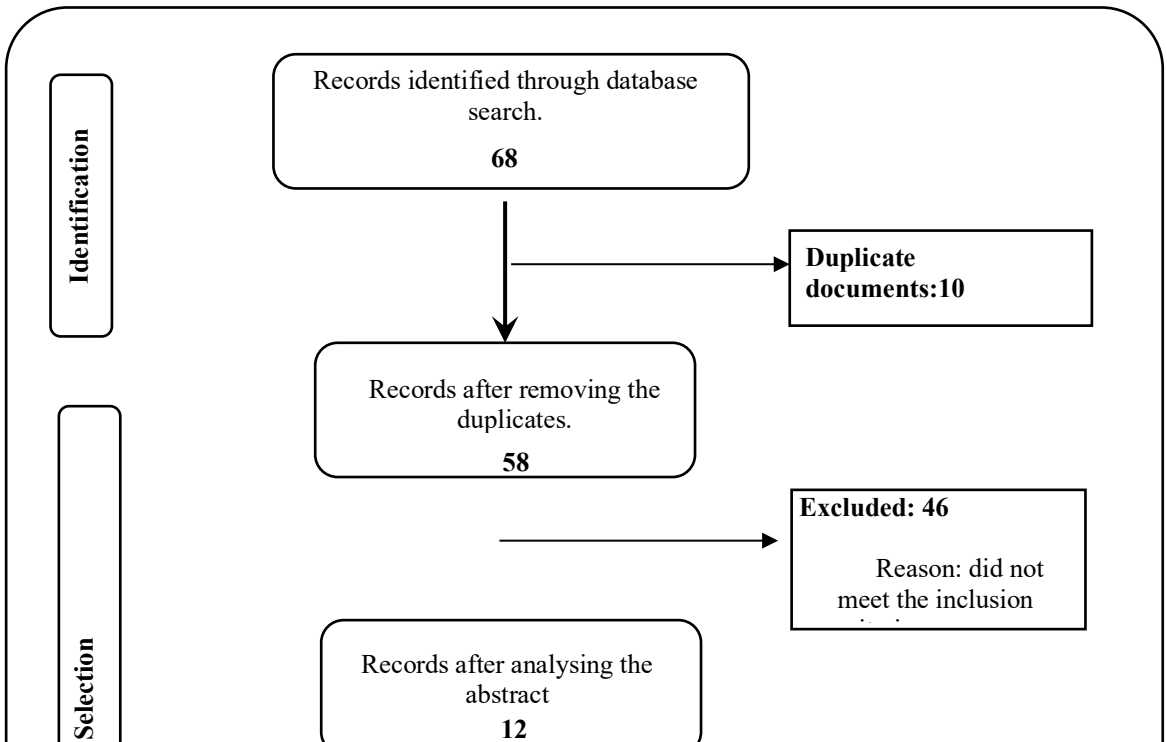
**Results**

Study selection

After a literature search using electronic databases and keywords, a total of 68 documents were identified. Of these, 46 documents did not meet the subject inclusion criteria. A total of 10 papers were discarded for being duplicated, three RCTs were excluded due to low scores on the PEDro scale, and two papers were not free in their full-text version. All RCTs selected have a minimum of 6 scores on the PEDro scale. Two RCTs present a score of 7 points, one document has a score of 8 points and two RCTs present a score of 9 points. The papers selected show good internal validity.

The present systematic review analysed a total of 7 RCTs (Figure 1).

The articles´ structural characteristics can be found in Table 2. Type of study, number of participants, age and type of tumour were all studied. Principal and secondary variables, as well as their changes after the intervention, are shown in Tables 3.1, 3.2 and 3.3.



Internal validity assessment

The PEDro scale (Table 1) was used to assess the study methodology. This scale consists of 10 points (selection criteria; randomisation of selection: concealed allocation; initial comparability between groups; all subjects blinded; all therapists blinded; all evaluators blinded; adequacy of follow-up; intention-to-treat analysis; comparison of results between groups; and the existence of point and variability measures), which may be dichotomous (Yes and No response) based on compliance or non-compliance with the requirements of the particular point.

Table 1. PEDro Scale.

| | **Randomised** | **Concealed allocation** | **Groups similar baseline** | **Blinding of subjects** | **Blinding of therapists** | **Blinding of evaluators** | **85 %** | **Intention to treat** | **Between-group** | **A point measure** | **Score PEDro** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Baima (2017) [7] | • | • | • | • | - | - | • | • | • | • | **8** |
| Byun (2022) [8] | • | • | • | • | • | - | • | • | • | • | **9** |
| Fatima (2022) [9] | • | • | - | • | • | • | • | • | • | • | **9** |
| Heima (2021) [10] | • | • | • | - | - | - | • | • | • | • | **7** |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Heima (2022) [11] | • | • | • | - | - | - | • | • | • | • | **7** |
| Knoerl (2022) [12] | • | • | - | - | - | - | • | • | • | • | **6** |
| Ligibel (2019) [13] | • | • | - | - | - | - | • | • | • | • | **6** |

Study characteristics

The characteristics of the included studies are described in Table 2. A total of 1,054 participants were analysed in this systematic review. The participants were aged 18-65 years and they all had a diagnosis of breast cancer. The intervention of prehabilitation shown by studies was a physical intervention. The most

repeated type of training was shoulder exercises, with a frequency of 2-5 days per week. Session time ranged from 30 to 75 minutes and the duration of prehabilitation was 2-4 weeks before surgery. All interventions were supervised by a health professional.

**Table 2**. Structural characteristics of the selected articles.

| Author | Patients (n) (women) | Age | Intervention | Outcome Variable |
|---|---|---|---|---|
| Baima (2017) [7] | 60 | x | IG: Shoulder exercises: Codman's exercise. Scapular squeezes. Reach for the pillow. 1-4 weeks prior to surgery and subjects were followed-up for 3 months after surgery. CG: Video about shoulder exercises. | ROM and pain |
| Byun (2022) [8] | 61 | 30-60 years | IG: Shoulder exercises and education information about the prevention of lymphatic edema. CG: Only education information about the prevention of lymphatic edema. | ROM, Pain, Disability of arm shoulder and hand, shoulder pain and disability index and arm circumferences |
| Fatima (2022) [9] | 36 | 35-65 years | IG: Shoulder exercise: active ROM as 5 min warm-up. Shoulder ROM 10-12 reps and 2-3 sets per day and then passive static stretching with 15-30 sec hold, 8-10 reps and 2-3 sets per day, 2-5 sessions per week. CG: Routine care was followed in both pre-operative and post-operative phases involving shoulder ROM for 10-12 reps, 2-3 sets per day. | ROM, pain and disability in activities of daily living. |

| | | | | |
|---|---|---|---|---|
| Heima (2021) [10] | 400 | + 18 years | IG: 30 min of aerobic physical activity supervised by a physiotherapist. Before surgery (2 weeks ±1 week) and 4 weeks after discharge from the hospital.<br>CG: The control group followed routine care and they did not receive any advice regarding physical activity. | Physical and mental recovery |
| Heima (2022) [11] | 400 | + 18 years | IG: 30 min of aerobic physical activity, moderate intensity, supervised by a physiotherapist. Before surgery (2 weeks ±1 week) and 4 weeks after discharge from hospital.<br>CG: The control group received brief information regarding the aim of the study and all patients received standard information regarding early mobilisation and shoulder movement after surgery according to routine care. | Physical recovery and quality of life. |
| Knoerl (2022) [12] | 49 | 52.8 (mean) years | IG: Combined supervised exercise. Sessions of 30-45 min of moderate-intensity aerobic exercise, 20 min of strength training and 10 min of cool down stretches.<br>CG: Book and relaxation audio guide. | Quality of life, stress, anxiety and physical function. |
| Ligibel (2019) [13] | 48 | 52.3 (mean) years | IG: Combined supervised exercise. 220 minutes of exercise per week, including 40 minutes of strength training and 180 minutes of moderate-intensity aerobic exercise. | To evaluate the impact of the exercise intervention on Ki-67. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | CG: Book and relaxation audio guide. | | | |

Prehabilitation results overview

All prehabilitation interventions included in this review are described in Tables 3.1, 3.2 and 3.3. Most of the select studies show two interventions for the participants (exercises and control). Three studies focused on shoulder exercises [7][8][9], two focused on aerobic training [10][11], and another two focused on combined training [12][13]. These studies analysed four objective variables and four subjective variables.

*Objective variables*

ROM was analysed by two studies [8][9], whose intervention consisted in shoulder exercises. The intervention group showed an improvement in ROM in the short term [9] and in the long term [8], although this improvement was not significant. Tumour markers did not show a significant improvement with combined training [13].

**Table 3.1.** Results from different studies that analysed ROM as an objective outcome variable.

| **Measurement instrument** | **Author** | | **Baseline** | **Short-term** (1-2 months) | **Medium-term** (3-6 months) | **Follow-up** |
|---|---|---|---|---|---|---|
| Goniometer | Byun (2022) [8] | Cases | Abduction 178.4(4.54)<br>Flexion 178.7(3.41)<br>External rotation 86.45 (8.77)<br>Internal rotation 7.16 (8.40) | 177.7 (4.97)<br>178.4 (3.74)<br>83.55 (10.18)<br>7.92 (9.00) | 178.1 (4.77)<br>178.4 (3.74)<br>84.19 (8.86)<br>7.47 (8.30) | 178.6 (3.55)<br>179.6 (3.55)<br>84.14 (8.27)<br>7.72 (8.78) |
| | | Control | Abduction 175.7(15.47) | 174.7 (11.06) | 176.0 (8.94) | 176.8 (14.8) |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Flexion 175.8 (15.87)<br>External rotation 85.33 (12.79)<br>Internal rotation 7.73 (9.04) | 173.7 (14.50)<br>81.00 (13.48)<br>8.46 (8.85) | 175.3 (11.06)<br>81.50 (12.26)<br>8.48 (8.82) | 176.5 (6.61)<br>80.00 (15.06)<br>8.42 (0.08) |
| Goniometer | Fatima (2022) [9] | Cases | • | Flexion day 1 129.67 (23.81)<br>Flexion day 3 135.67 (17.915)<br>Abduction day 1 127.00 (20.857)<br>Abduction day 3 136.00 (17.44)<br>External rotation day 1 59.67 (9.904)<br>External rotation day 3 67.00 (10.316) | • | • |
| | | Control | • | Flexion day 1 110.67 (26.040)<br>Flexion day 3 120.00 (21.297)<br>Abduction day 1 108.67 (20.219)<br>Abduction day 3 119.00 (17.029)<br>External rotation day 1 52.00 (13.601)<br>External rotation day 3 57.33 (13.998) | • | • |

*Subjective variables*

Pain was a variable analysed by three studies [7][8][9], where VAS was the measurement instrument employed [7][8][9]. The intervention groups show fewer points of VAS pre-surgery [8] and 1-day post-surgery [9]. At three months, 100% of participants of the control group had pain versus 8% of participants of the intervention group [7].

Physical recovery was studied by three articles [10][11][12]. The intervention was aerobic training [10][11] and combined training [12]. Different measurement instruments were employed (SGPALS [10], FACT-B [11], and 7-Day PAR [12]). Four weeks after surgery, 48% of patients in the intervention group recovered at 100% versus 45.2% of the control group [10]. Before surgery, the intervention group increased physical activity versus the control group with aerobic training [11] and combined training [12].

Disability was analysed by two studies [8][9]. The measurement instruments employed were DASH [8] and GARS [9]. The intervention groups showed less disability pre-surgery versus the control group [8]; after surgery, the patients who received prehabilitation showed 2.46 points less disability versus the control group at 1 day post-surgery [9] and 4.74 points less disability at 3 days post-surgery [9].

Mental recovery was analysed in only one study [10]. Aerobic training was the intervention employed [10]. At 30 days post-surgery, 15.6% of the participants in the intervention group showed complications versus 18.4% in the control group [10]. Similarly, at 90 days post-surgery, the intervention group showed fewer mental complications versus the control group [10].

Quality of life was analysed by two studies [11][12]. In the long term, no differences were observed between the study groups [11] (see Table 3). At l month post-surgery, the intervention group showed an improvement of 5.8% versus 4.4% of the control group [12]. The measurement instruments and intervention were different in both groups.

Psychological variables were analysed in only one study [12]. Anxiety and stress showed higher pre-surgery results in the prehabilitation group, but this improvement was not significant in the long term. The intervention of this study was combined exercise [12].

**Table 3.2.:** Results from different studies that analysed pain as a subjective outcome variable

| Variable | Measurement instrument | Author | | Baseline | Short-term (1-2 months) | Medium-term (3-6 months) | Follow-up |
|---|---|---|---|---|---|---|---|
| PAIN | VAS | Baima (2017) [7] | Cases | • | 24% patients have pain | 15% patients have pain | • |
| | | | Control | • | 50% patients have pain | 100% patients have pain | • |
| | VAS | Byun (2022) [8] | Cases | 0.52 (1.69) | 1.55 (2.06) | 1.13 (1.50) | 0.51 (1.01) |
| | | | Control | 2.23 (11.50) | 3.00 (3.69) | 2.10 (2.72) | 0.97 (1.64) |
| | VAS | Fatima (2022) [9] | Cases | • | Day 1 3.40 (1.639) | • | • |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Day 3 1.40 (1.056) | | |
| | | | Control | • | Day 1 4.73 (1.580)<br>Day 3 2.87 (1.642) | • | • |

VAS: visual analogue scale.

**Table 3.3:** Results from different studies that analysed tumor makers and other variables as outcome variables

| Variable | Measurement instrument | Author | | Baseline | Short-term (1-2 months) | Medium-term (3-6 months) | Follow-up |
|---|---|---|---|---|---|---|---|
| **Tumour Markers** | Wilcoxon rank-sum test | Ligibel (2019) [13]. | Cases | 23.7 (14.6) | 22.6 (12.9) | • | • |
| | | | Control | 18.5 (18.3) | 17.8 (8.1) | • | • |
| **OTHER VARIABLES** | Short DASH score (disability),<br>SPADI Score (shoulder pain and disability index) and tape measure (volume). | Byun (2022) [8] | Cases | Short DASH score 0.52(1.69)<br>SPADI score 0.32(1.14)<br>Tape measure (above elbow 5 cm) 24.81 (2.42)<br>Tape measure (below elbow 5 cm) 23.09 (2.00) | Short DASH score 2.35(2.96)<br>SPADI score7.42(10.54)<br>Tape measure (above elbow 5 cm) 24.79 (2.59)<br>Tape measure (below elbow 5 cm) 23.35 (2.02) | Short DASH score 1.39(1.86)<br>SPADI score 3.29 (3.93)<br>Tape measure (above elbow 5 cm) 24.91 (2.39)<br>Tape measure (below elbow 5 cm)23.33 (2.08) | Short DASH score 0.57(1.01)<br>SPADI score 1.08 (2.02)<br>Tape measure (above elbow 5 cm) 25.07 (2.60)<br>Tape measure (below elbow 5 cm) 23.68 (2.20) |
| | | | Control | Short DASH score 2.23(11.50)<br>SPADI score 0.83 (4.04) | Short DASH score 3.00(3.69)<br>SPADI score 6.33(8.52) | Short DASH score 2.10(2.72)<br>SPADI score 4.53(5.83) | Short DASH score 0.97(1.64)<br>SPADI score 1.19(2.09) |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Tape measure (above elbow 5 cm) 24.59 (2.53)<br>Tape measure (below elbow 5 cm)23.04 (2.09) | Tape measure (above elbow 5 cm)24.86(2.60)<br>Tape measure (below elbow 5 cm) 23.14 (2.11) | Tape measure (above elbow 5 cm) 25.07 (2.88)<br>Tape measure (below elbow 5 cm) 23.27 (2.45) | Tape measure (above elbow 5 cm) 24.78 (2.55)<br>Tape measure (below elbow 5 cm) 23.18 (2.45) |
| GARS (shoulder mobility) | Fatima (2022) [9] | Cases | | Day 1 53.27 (3.474)<br>Day 3 34.93 (3.807) | • | • |
| | | Control | | Day 1 55.73 (4.559)<br>Day 3 39.67 (2.920) | • | • |
| SGPALS (physical activity) and CCI (complication). | Heima (2021) [10] | Cases | • | At 4 weeks after surgery decrease 26 of 142 (18.3) SGPALS | 4.2 (0-57.7) CCI | • |
| | | Control | • | At 4 weeks after surgery decrease 37 of 162 (22.8) SGPALS | 4.7 (0-48.3) CCI | • |
| FACT-B (functional assessment) | Heima (2022) [11] | Cases | 117.5 FACT-B | 121.0 FACT-B | • | 119.1 FACT-B |
| | | Control | 116.8 FACT-B | 121.5 FACT-B | • | 121.9 FACT-B |
| EORTC QLQ C-30 (quality of life), HADS (hospital anxiety and depression), PSS (stress) and 7-Day PAR (physical activity). | Knoerl (2022) [12] | Cases | 74.0 (15.3) EORTC QLQ C-30<br>8.3 (3.4) HADS | After surgery<br>83.7 (14.1) EORTC QLQ C-30<br>1 month after surgery<br>79.8 (15.0) EORTC QLQ C-30<br>After surgery | • | • |

| | | | | | |
|---|---|---|---|---|---|
| | | 14.7 (7.2) PSS | 7.9 (3.9) HADS | | |
| | | | 1 month after surgery<br>6.2 (3.3) HADS | | |
| | | 95.6 (6.5) 7-Day PAR | After surgery<br>12.9 (7.2) PSS | | |
| | | | 1 month after surgery<br>11.3 (7.2) PSS | | |
| | | | After surgery<br>95.7 (5.7) 7-Day PAR | | |
| | | | 1 month after surgery<br>92.3 (6.8) 7-Day PAR | | |
| | | 79.8 (15.0) EORTC QLQ C-30 | After surgery<br>78.6 (16.8) EORTC QLQ C-30 | | |
| | | 9.2 (2.5) HADS | 1 month after surgery<br>73.4 (18.80 EORTC QLQ C-30 | | |
| Control | | 18.4 (5.5) PSS | After surgery<br>7.6 (2.1) HADS | • | • |
| | | | 1 month after surgery<br>6.3 (2.1) HADS | | |
| | | 94.6 (11.1) 7-Day PAR | After surgery | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | 14.5 (6.0) PSS<br>1 month after surgery<br>13.8 (5.6) PSS<br>After surgery<br>96.8 (8.8) 7-Day PAR<br>1 month after surgery<br>85.8 (17.9) 7-Day PAR | | |
| Tissue collection, tissue analysis, fluorescence IHC and tumour annotation and digital image analysis for immunological markers. | Ligibel (2019) [13] | Cases | 23.7 (14.6) | - 1.1 (12.9) | ● | ● |
| | | Control | 18.5 (18.3) | -0.7 (8.1) | ● | ● |

Short DASH: Disability of Arm, Shoulder and Hand. SPADI Score: Shoulder Pain and Disability Index. ABD: Abduction. FLEX: Flexion. NPRS: Numeric Pain Rating Scale; GARS: Groningen Activity Restriction Scale; SGPALS: Saltin–Grimby Physical Activity Level Scale; CCI: Comprehensive Complication Index. FACT-B: Functional Assessment of Cancer Therapy-Breast; EQ-VAS: EuroQol-visual analog scale; EORTC QLQ C-30: European Organisation for Research and Treatment of Cancer Quality of Life Core Questionnaire-30; PSS: Perceived stress scale; HADS: Hospital anxiety and depression scale;7-Day PAR: 7-Day Physical Activity Recall; QoL: Quality of Life

**Discussion**

It is necessary to consider ways in which to maximise treatment effectiveness of individuals diagnosed with cancer and minimise adverse effects. Prehabilitation in oncology patients could be an interesting strategy. This review aimed to analyse changes in objective and subjective variables in breast cancer patients of prehabilitation intervention versus other interventions. A total of 1,054 patients were analysed in this review. All objective variables showed an improvement in the intervention group versus the control group [8][9]. The subjective variables also presented an improvement, although the psychological variables did not obtain a significant improvement in the long term [10][11][12].

*Objective variables*

Three studies analysed objective variables (ROM and tumour markers) [8][9][13]. In the short term, the intervention group´s ROM presented lower loss versus the control group in all physiological measurements [8][9]. The improvement in the ROM of the intervention groups ranged between 0.76º [8] and 18.3º [9]. In the study of Byun [8], the improvement was little significant, as the intervention and control groups presented an improvement of 0.76º and 0.73º, respectively. However, Fatima´s study [9] shows an improvement of up to 18.3º in ROM. This significant improvement could be due to this author's proposal of a combined intervention of active exercises and passive static stretching [9]. It seems that a combined intervention in oncology patients is an interesting option to obtain benefits in this population. Other studies about oncology patients proposed combined exercise intervention, obtaining significant improvement in objective variables like 6MWT [14].

In the medium term and follow-up, only one study evaluated the ROM of participants [8]. The results found were not significant, since both the intervention group and the control group presented improvement in the diverse physiological movements [8]. This non-significant improvement could be due to the type of intervention. As in the short term, an intervention with combined exercises could generate a significant improvement in breast cancer patients. This significant improvement, in objective variables in the medium term and follow-up, can be found in studies with rehabilitation intervention in breast cancer patients, whose authors propose combined training [15].

Another objective variable analysed in the short term was tumour marker Ki-67 [13]. A combined supervised exercise intervention reduced Ki-67 by 1.1% versus 0.7% in the control group [13]. This improvement was not significant, although a longer programme and measuring the variable in the medium term would have generated better results. In metastatic patients [16] an intervention of 12 weeks generated a significant improvement in their tumour markers, which could also be observed in breast cancer patients.

*Subjective variables*

The subjective variables analysed in this review were pain, physical and mental recovery, disability, and psychological variables. Three studies evaluated pain in patients with breast cancer [7][8][9].

The pain variable presented changes in the intervention group of all studies. In the short term, the patients who did shoulder exercises presented pain in 24% of cases [7]. However, the patients who did not carry out the exercise intervention presented pain in 50% of cases [7]. With shoulder exercises alone, the patients reduced their pain, although this variable also decreased with combined training. The intervention group, which performed combined training, presented, at 1-day post-surgery, 1.33 points less versus the control

group [9]. This type of training also generates improvement in the pain of patients with breast cancer undergoing treatments [15]. Andréa Dias et al. [15] reported that an intervention with combined training in breast cancer patients improved their pain in 2 points at 12 weeks of intervention. However, an intervention ibwith shoulder exercises and education did not generate changes in the short term [8].

In the medium term, only two studies analysed this variable [7][8]. Only 15% of patients who conducted shoulder exercises for 1-4 weeks presented pain [7]. On the other hand, 100% of patients in the control group had pain three months post-surgery [7]. It seems that performing shoulder exercises for 1-4 weeks pre-surgery generates a significant improvement in the pain of breast cancer patients [7]. An intervention with shoulder exercises plus education reduced only 0.48 points the breast cancer patients´ pain [8]. Interventions with education alone generate few changes in the patients, but they could be a good complementary intervention strategy.

Only one study evaluated pain in the long term [8]. The improvement was not clinically significant, since the intervention group improved the pain by 0.01 points and the control group worsened the pain by 1.26 points [8]. It is possible that, in order to guarantee a long-term improvement, the type of intervention should be combined training, and the duration should be 12 weeks, given that this intervention generates improvement in the long-term in breast cancer patients [17].

Five studies [8][9][10][11][12] evaluated physical and mental recovery. The results were analysed in the short, medium and long term, with diverse measurement instruments. In the short term, the experimental group presented 4.74 points less than the control group in the GARS scale [9]. The patients who did shoulder exercises 2-5 days per week presented better physical activity than the control group, at 3 days post-surgery [9]. An intervention proposed by Byun [8] about shoulder exercises and education did not generate benefits in the short term in the intervention group. However, in the medium term, the difference between both groups was more relevant, with the intervention group showing better physical recovery than the control group [8]. This intervention could be interesting to obtain good results in the medium term. With an aerobic supervised training, patients with breast cancer presented 0.5% lower probability of generating complications post-surgery, in the medium term [10]. The same was observed in colonic cancer patients who did physical pre-habilitation [14]. After a combined training of 4 weeks, the intervention group presented a 3% lower probability of developing complications post-surgery compared to the control group [14]. A longer combined training may produce better results in breast cancer patients.

With an aerobic intervention, physical recovery in the short term was not significant, since both groups showed a decrease [11]. Nonetheless, the experimental group presented better physical recovery than the control group, despite having worse physical activity than pre-surgery [11]. However, in the long term, this intervention generates in the patients benefits in their physical recovery, since the experimental group had 3.5 points less on disability compared with the control group (measured by instrument FACT-B) [11].

Mental recovery was analysed by only one study in the short term [12]. Mental recovery encompassed diverse psychological aspects: quality of life, anxiety and stress [12]. The results were not clinically significant, although the experimental group presented less stress, at 1 month post-surgery, than the control group [12]. The intervention proposed (combined and supervised training) did not seems to be the most adequate to improve mental recovery in breast cancer patients [12]. Other alternatives of training like yoga and meditation seem to generate better benefits in psychological aspects in breast cancer patients [18].

**Strengths and Weaknesses**

To our knowledge, this is the first systematic review to analyse the effect of prehabilitation, both on objective and subjective variables, in patients with breast cancer. However, this study presents some weaknesses that should be taken into account when interpreting the results. Only studies published in 5

languages (English, Spanish, Italian, French and Portuguese) were selected; thus, there may be other randomised control trials which were not included in the present review. Similarly, despite the search having been carried out in 8 leading databases, there could be other studies in other databases which were not included in the present review.

## Conclusion

Physical prehabilitation is an interesting strategy to generate changes in breast cancer patients. Objective variables (ROM and tumour markers) improve in patients who carry out prehabilitation. Subjective variables (pain, physical and mental recovery) improve in those participants who conduct prehabilitation. However, it seems that only-physical prehabilitation does not improve psychological variables (stress, anxiety and depression) in the long term.

It would be interesting to carry out future studies which contemplate a long-term intervention and which combine other aspects, such as psychological and nutritional factors.

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