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# Supplementary materials

*Supplementary material A*

## Search strategy

*Aquatic exercise*

*aquatic exercise, water exercise, water therapy, aquatic therapy, aquatic physical therapy, water physical therapy, hydrotherapy, water training, aquatic training, aquatic treatment, water treatment.*

*Breast cancer*

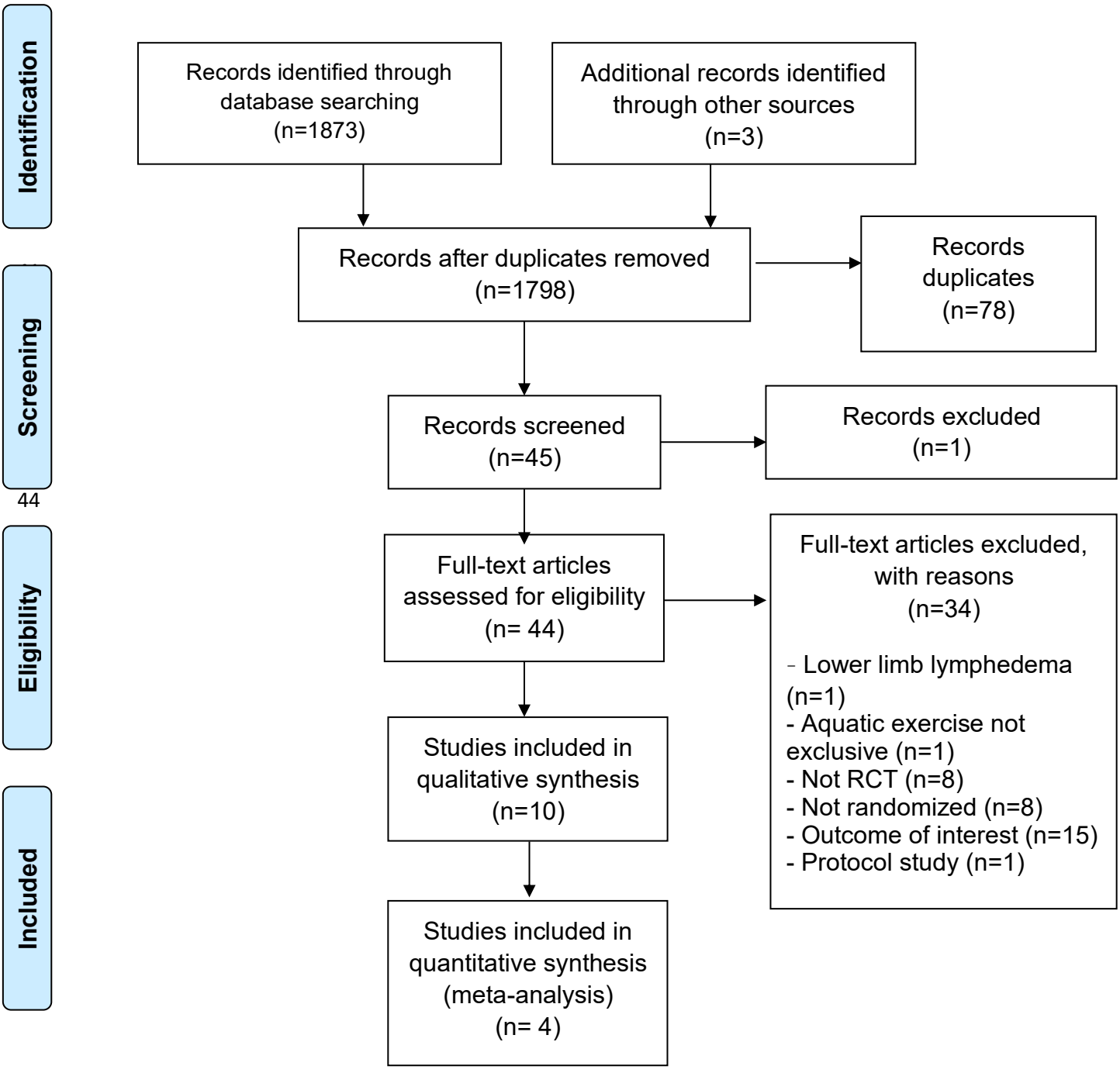
*breast cancer, breast neoplasm, breast neoplasm malignant, unilateral breast neoplasm, triple negative breast neoplasms, breast neoplasms male, breast tumor, mammary cancer, malignant neoplasm of breast, malignant tumor of breast, cancer or breast, cancer of the breast, human mammary carcinoma, human mammary neoplasm, breast carcinoma, breast carcinoma in situ, inflammatory breast neoplasm*

*Study design*

*randomized controlled trial, equivalence trial, controlled clinical trial, clinical study, intention to treat, clinical trial, meta-analyses, systematic review, guidelines.*

*Supplementary material B*

**PRISMA Flow Diagram**



*Supplementary material C*

**Characteristics of interventions.**

| Study | Population | Intervention | Comparator | Outcomes | Time | Follow-up | Results |
|---|---|---|---|---|---|---|---|
| Ali et al., 2021[56] Egypt RCT | n=50 (AE=25, Land exercise=25) AE: $\bar{x}$= 51.3 yrs (SD=9.1) Land exercise: $\bar{x}$= 49.8 yrs (SD=8.5) Breast cancer and undergone unilateral excision of the axillary | AE: 60 min, 3x week, 8 weeks. Land exercise: 60 min, 3x week, 8 weeks. | AE X Land exercise | Lymphedema Shoulder ROM (goniometer) Pain (VAS) | 2 years post-surgery | None | Lymphedema: (*P*<0.001) ROM: (flexion: *P* <0.001; abduction: *P* <0.001) Pain: (*P*<0.001) |

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| | nodes and moderate degree or stage I-II lymphedema | | | | | | |
| Cantarero-Villanueva et al., 2012b[57] Spain RCT | n=66 (AE=33, usual care =33) AE: $\bar{x}$= 48 yrs (SD=8) Usual care: $\bar{x}$=47 yrs (SD=9) Cancer stages I-III Simple mastectomy or quadrantectomy with breast reconstruction (hormone therapy). | AE: 60 min, 3x week, 8 weeks. | AE X usual care | Pain (VAS) Pressure pain threshold (algometer) | Not reported | None | Neck: pain (*P*<0.001) Shoulder: pain (*P*=0.046) |

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| | Pain - EVA (excluded lymphedema) | | | | | | |
| Cantarero-Villanueva et al., 2013[54] Spain RCT | n=61 (AE=29, usual care =32) AE: x̄= 49 yrs (SD=7) Usual care: x̄= 47 yrs (SD=8) Cancer stages I-IIIa Lumpectomy or mastectomy (hormone therapy). | AE: 60 min, 3x week, 8 weeks. | AE X usual care | Fatigue (PSF) | Not reported | 6 months | Fatigue: ($P$<0.001) |

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| | Fatigue in the last 18 months <3 on the PSF. | | | | | | |
| Johansson et al., 2013[59] Sweden Pilot | n=29 (AE=15, usual care =14) AE: Md= 64 yrs (25-75 %=56-74) Usual care: Md=62 yrs (58-71) Mastectomy + Lymphedema for at least 6 months. | AE: 30 min, 2x week, 8 weeks. | AE X usual care | Lymphedema (perometry, BIS, %RLV) ROM (goniometer) | 10 months after surgery | None | Lymphedema vol.: NS Shoulder ROM (ER: *P*=0.7; flexion: *P*<0.001; abduction: *P*=0.32) |

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| Letellier et al., 2014[58] Canada Pilot | n=25 (AE=13, usual care =12) AE: $\bar{x}$= 56.4 yrs (SD=9.7) Usual care: $\bar{x}$= 53.4 yrs (SD=9.3) Mastectomy + Lymphedema. | AE: 60 min, 1x week, 12 weeks. | AE (+ home exercise) X usual care (home exercise - DVD). | Lymphedema (%RLV) Pain (MPQSF) QoL (FACIT-B) Function (DASH) | 6 months after surgery | None | Lymphedema vol.: NS Pain: (*P*=0.025) QoL: (*P*=0.021) Function: (*P*=0.016) |
| Odynets et al., 2018[55] Ukraine RCT | n=68 (AE=34, Land exercise=34) AE: $\bar{x}$= 57.4 yrs (SD=2.1) | AE: 60 min, 3x week, 12 weeks. | AE X Land exercise (Pilates method) | QoL: (EORTC QLQ-BR23) | 6 months after surgery | None | QoL: (Pain: *P*<0.05; body image: *P*<0.01; breast symptoms: *P*<0.05; arm symptoms *P*<0.05) |

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| | Land exercise: x̄= 57.9 yrs (SD=2.2)<br><br>Madden mastectomy. | | | | | | |
| Odynets et al., 2019d[60] Ukraine RCT | n=85/115 (AE=45, Land exercise (Pilates method) =40<br>AE: x̄= 58.8 yrs (SD=1.36)<br>Land exercise: x̄= 59.4 yrs (SD=1.2)<br>Madden mastectomy. | AE: 60 min, 3x week, 48 weeks (1 year). | AE X Land exercise (Pilates method) X Land exercise (Yoga) | QoL (FACIT-B) | 5 months after surgery | None | QoL: (*P*<0.001) |

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| Odynets et al., 2019e[61] Ukraine RCT | n=85 (AE=34, Land exercise =34) AE: x̄= 57.4 yrs (SD=2.1 yrs) Land exercise: x̄= 57.9 yrs (SD=2.2) Modified radical mastectomy. | AE: 60 min, 3x week, 12 weeks. | AE X Land exercise (Pilates method + swimming) | ROM (goniometer) Lymphedema (circumference) | Up to 6 months after surgery | None | ROM: (flexion: *P* <0.001, abduction: *P* <0.01) Lymphedema: (forearm: *P* <0.05) |
| Thidar & Katz-Leurer, 2010[53] Israel RCT | n=48 (AE=16, usual care =32) AE: x̄= 56.2 yrs (SD=10.7) | AE: 45 min, 1x week, 12 weeks. | AE X usual care (self-management) | Lymphedema (% RLV) QoL (ULL-27) | 6 years after surgery | None | Lymphedema: (Post first session: *P*=0.02; post last session: *P*<0.01). QoL: (Emotional *P*=0.03; Social: *P*=0.01) |

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| | Usual care: x̄= 56.5 yrs (SD=8.8). Lumpectomy or mastectomy + Lymphedema (hormone therapy). | | | | | | |
| Mur-Gimeno, 2024[62] Spain RCT | n=28 (AE=14, Land exercise=14) Age: 50-60 yrs. Breast cancer (hormone therapy). | AE: 60 min, 2x week, 12 weeks. Land exercise: 60 min, 2x week, 12 weeks. | AE X Land exercise | QoL (EORTC-QLQ C30) Fatigue (PSF) | Not reported | 3 months | QoL: (symptom severity: ($P$ = 0.003), overall functioning ($P$ =0 .013)). |

AE: Aquatic Exercise; QoL: Quality of Life; RCT: Randomized Controlled Trial; PFS: Piper Fatigue Scale; VAS: Visual Analogue Scale; NS: Not significant; EORTC QLQ BR23: European Organization for Research and Treatment of Cancer Breast Cancer-Specific Quality of Life questionnaire; %RLV: Relative Lymphedema Volume; ROM: Range of Motion; ER: External Rotation; MPQSF: McGill Pain Questionnaire Short Form; and FACIT-B: Functional Assessment of Cancer Therapy Breast Cancer.

*Supplementary material D*

**Characteristics of the interventions**.

| Study | Pool temperature | Treatment | Individual/ group and supervision | Adverse effects | Adherence |
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| **Ali et al., 2021 Egypt RCT** | 30-32 °C | Land exercise: 10 min of warm-up exercises, 30–40 min of exercise for muscle strength using dumbbells with free weights.<br>AE: Patients in the intervention group underwent the same supervised land-based exercise program as the control group, but in water. | Not reported | Throughout the study period, none of the patients complained of infection or adverse effects of increased limb volume. | Not reported |
| **Cantarero-Villanueva et al., 2012b** | 32 ºC (28-31 ºC) | 10-min warm-up consisting of slow aerobic, mobility, and stretching exercise; 35-min of aerobic, low-intensity endurance, and core | 10-12 participants, supervised by | Three women reported a transient increase in edema, and four women noted an increase in | 85 % |

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| **Pain Spain RCT** | | stability training; and a 15-min cool-down period including stretching and relaxation exercises focusing on the neck/ shoulder region. | two physical therapists | fatigue immediately after the beginning of the first session, which improved in the next few days. These women did not drop out of the study. No other adverse events were recorded during the study | |
| **Cantarero-Villanueva et al., 2013 Spain RCT** | 28 ºC | 10-min of warm-up, 40-min of aerobic and endurance exercises, and 10-min of cool-down exercises. | 10-12 participants, supervised by a fitness specialist and by 2 physical therapists | Discomfort, low intensity pain / stiffness after an exercise session in 3 participants. | 84 % |

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| **Johansson et al., 2013 Sweden Pilot** | Not reported | Women were instructed to spend the time swimming and/or performing shoulder exercises in the water continuously for 30 mins. | Exercises during the first session only, whereas all other sessions were unsupervised | There were no serious adverse events related to the intervention. | 79 % |
| **Letellier et al., 2014 Canada Pilot** | 31-33 ºC | Self-massage, corrective exercises for ROM, strengthening exercises. Low intensity. The participants were encouraged to complete additional unsupervised weekly sessions and to perform at least 25 to 30 mins of the DVD exercise on the other days of the week and/or any other type of exercise. | Not reported, without supervision | There were no serious adverse events related to the intervention. | 62 %, participated in 9 sessions or more and 77 %, attended 6 sessions |

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| | | | | | or more of 12 (ranging from 0 to 12 sessions) |
| **Odynets et al., 2018 Ukraine RCT** | Not reported | AE: was built on a rational combination of swimming, combined developing exercises, and exercises of local impact on different muscle groups with various initial positions: standing, half-squatting, sitting, lying on noodles.<br>Land exercise: the Pilates program was conducted on the floor and included warm-up, the main part with a resistance band, and cool-down. | Not reported | Not reported | Not reported |

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| **Odynets et al., 2019d Ukraine RCT** | Not reported | AE: breathing (static and dynamic) and physical (active, active-passive, special, combined developing, and sports-applied) exercises that helped solve current tasks<br>Pilates method: Pilates exercises were performed on the floor and included warmup, a main part using a resistance band, and cool-down.<br>Yoga: warmup 10 min, followed by exercising 40 min, and ended by cooling down 10 min. | Not reported | Not reported | 92 %, in group A 90 %, in group B, and 94 % in group C. |
| **Odynets et al., 2019e Ukraine RCT** | Not reported | AA: aqua aerobics (aqua jogging, aqua building, aqua stretching), conditional swimming, and recreational aerobics.<br>Land exercise: program included conditional swimming and Pilates exercises. | Individual | Not reported | Not reported |

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| | | Intensity for women ranged from 40% to 60% of heart rate reserve. | | | |
| **Thidar & Katz-Leurer, 2010 Israel RCT** | 32-33 ºC | ALT: The sequence of exercise is important. First, healthy lymphotomes are activated proximally to clear the reservoir, by breathing exercises. Second, proximal movements of chest and shoulder girdle and manual techniques of self-massage are performed. Lastly, work is performed to clear the affected lymphotomes into the healthy ones by vertical positioning of the arm in the water and performing self-massage and distal movements that involve the elbows, wrists, and fingers. | Not reported | None of the women suffered from any infections during the study period. | 79 % |

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| **Mur-Gimeno, 2024 Spain RCT** | Sea-salt swimming pool 29° | AE: warm-up; endurance and resistance training and cool down. | Not reported | There were no serious adverse events related to the intervention. | 86,3 for AE and 82,7 % for Land exercise. |

AE: Aquatic Exercise; AA: Aqua Aerobics; RCT: Randomized Controlled Trial; ROM: Range of Motion; and ALT: Aqua Lymphatic Therapy.

*Supplementary material E*

Using GRADE to classify the certainty of evidence.

| **№ of studies** | **Study design** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Outcome** | ***Timepoint*** | **n (aquatic exercise)** | **n (control group[1] or land exercise[2])** | **Effect (absolute risk 95% CI)** | **Quality of evidence (GRADE)** | **importance** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | RCT | serious | very serious | not serious | very serious | quality of life - emotional | 6 months and 6 years after surgery | 59 | 59[1] | SDM=0.58 (0.19, 0.98) | ⊕ Very low[bcd] | CRITICAL |
| 2 | RCT | serious | very serious | not serious | extremely serious | pain | 6 months and 2 years after surgery | 61 | 48[2] | SDM=1.10 (-1.54,-3.74) | ⊕ Very low[abcd] | CRITICAL |

Quality of evidence:
High: We are very confident that the true effect lies close to that of the estimate of the effect.
Moderate: We are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low: Our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low: We have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of the effect.*;*

Reason for downgrade:
[a]$I^2$ greater than 70 % (serious inconsistency).
[b]Reason for downgrade: sample size lower than 400 (serious imprecision).
[c]Reason for downgrade: trials rated as high risk of bias (serious risk of bias) and lack of consistency of the results (serious inconsistency).
[d]Reason for downgrade: lack of consistency of the results (serious inconsistency) and sample size lower than 400 (serious imprecision).