



QUALITY IN SPORT

eISSN 2450-3118 · Open Access · Peer-reviewed

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CHYŁA, Zofia, BRAKSAL, Barbara, CIEŚLEWICZ, Karolina, CZĘCZEK, Kacper, MINIK, Bartosz, SZYMAŃSKA-ZDYB, Kinga, NOWACZEK, Patrycja, MIRKOWSKI, Krzysztof, SZUREK, Zuzanna Wanda and MIROŃSKI, Adam. Health-oriented Physical Exercise And Rehabilitation In Breast Cancer-related Lymphedema: Safety, Functional Outcomes And Quality Of Life - A Narrative Review. *Quality in Sport*. 2026;75:75124. <https://doi.org/10.12775/QS.2026.75.75124>

ARTICLE TIMELINE

Received: 07.08.2026. Accepted: 02.09.2026. Published: 23.09.2026.

The journal has been awarded 20 points in the parametric evaluation by the Polish Ministry of Higher Education and Science (Annex to the announcement of 05.01.2024, No. 32553). Unique Journal Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).

Punkty Ministerialne z 2019 – aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych). © The Authors 2026.

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HEALTH-ORIENTED PHYSICAL EXERCISE AND REHABILITATION IN BREAST CANCER-RELATED LYMPHEDEMA: SAFETY, FUNCTIONAL OUTCOMES AND QUALITY OF LIFE - A NARRATIVE REVIEW

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Abstract

Background. Breast cancer-related lymphedema (BCRL) is a chronic complication of breast cancer treatment that can limit upper-limb function, daily activity and quality of life. Former advice to avoid strenuous arm use has been challenged by exercise-oncology evidence.

Aim. This narrative review summarises evidence on exercise and rehabilitation in women with or at risk of BCRL, focusing on safety, function, surveillance and practical prescription.

Material and methods. PubMed/MEDLINE, PubMed Central, NCBI Bookshelf, open-access platforms and guideline sources were searched for free full-text publications from 2016 to 2026. The final synthesis included 31 trials, reviews, cohort studies, consensus statements and guidelines.

Results. Slowly progressive resistance training is safe for most clinically stable women with or at risk of BCRL. Aerobic exercise, combined programmes, early mobility, yoga, Pilates-based rehabilitation and aquatic exercise are generally safe when individualised and progressed gradually. Exercise may improve strength, shoulder function, symptoms, fatigue, confidence and quality of life, although optimal dose and compression use remain uncertain.

Conclusions. Physical activity should be integrated into BCRL pathways with education, skin care, weight-management support, indicated compression and specialist referral for unstable cases. Exercise should be treated as a core component of survivorship care rather than as a risk to be avoided.

Key words: breast cancer; lymphedema; physical activity; exercise oncology; resistance training; rehabilitation; survivorship.

1. Introduction

Breast cancer survival has improved in many countries, which has shifted attention from short-term oncological endpoints towards long-term survivorship, function and quality of life. Breast cancer-related lymphedema (BCRL) remains one of the most distressing chronic complications after breast cancer treatment. It may involve the arm, hand, breast, chest wall or trunk on the treated side and can be accompanied by heaviness, tightness, pain, impaired range of motion, recurrent infection, cosmetic concern and fear of progression [1, 2].

The burden of BCRL is clinically relevant because many risk factors are linked to treatments that improve cancer control. Axillary lymph node dissection, sentinel lymph node biopsy, regional nodal irradiation, mastectomy, taxane-based chemotherapy, higher body mass index, infection and the number of nodes removed have all been associated with risk, although estimates vary according to diagnostic method and follow-up duration [1, 2, 3, 12]. A

nationwide Korean cohort reported an overall incidence of 12.2%, with the highest rate after modified radical mastectomy [3].

Historically, survivors were often advised to protect the affected limb by avoiding heavy, repetitive or strenuous arm use. This advice was understandable when evidence was limited, but it also produced fear, deconditioning, reduced shoulder mobility, weight gain and avoidance of ordinary activity. Contemporary evidence has changed the clinical question from whether the arm should be used to how it should be used safely, progressively and confidently [4, 5, 6].

Physical activity is now recognised as an important component of cancer survivorship. Exercise can improve cardiorespiratory fitness, muscle strength, fatigue, depressive symptoms, anxiety, body composition, physical function and health-related quality of life [4, 16, 17]. For women with or at risk of BCRL, the main clinical task is to integrate exercise with surveillance, skin care, indicated compression and symptom-guided progression rather than to prescribe either unrestricted loading or fear-based avoidance.

Research objective. The objective of this narrative review is to synthesise current evidence on health-oriented physical exercise and rehabilitation in BCRL, with emphasis on safety, functional outcomes, quality of life and practical exercise prescription. The review aims to translate contemporary exercise-oncology and lymphedema evidence into a practical, symptom-guided rehabilitation model for oncology rehabilitation, physiotherapy, exercise professionals, nurses and survivorship teams.

Research problems. This review addresses four problems: whether physical activity increases the risk of BCRL onset or exacerbation; which exercise modalities have the strongest evidence; how exercise should be integrated with compression, surveillance, skin care, weight management and education; and which uncertainties remain regarding dose, timing, supervision, compression use and implementation in routine survivorship care.

Added value and practical relevance. The added value of this review is the translation of contemporary exercise-oncology and lymphedema evidence into practical guidance for safe return to physical activity, supervised exercise, recreational sport and long-term active living after breast cancer treatment. The synthesis emphasises progressive loading, surveillance, compression decisions, patient education, quality of life and referral thresholds rather than repeating only the general conclusion that exercise is safe.

2. Research materials and methods

2.1. Design. This article is a narrative review. A narrative approach was selected because the topic integrates clinical, mechanistic and practical evidence relevant to rehabilitation, physiotherapy, oncology nursing, sports science and survivorship care. Narrative synthesis was selected because the evidence includes heterogeneous interventions, different stages of BCRL, different diagnostic methods, varied exercise modalities and clinical guidelines that cannot be fully summarised by a single pooled estimate.

2.2. Search strategy and sources. Literature was identified through searches of PubMed/MEDLINE, PubMed Central, NCBI Bookshelf, guideline repositories and open-access journal platforms. The last search update was performed in May 2026. Search terms included breast cancer, lymphedema, lymphoedema, breast cancer-related lymphedema, breast cancer-related lymphoedema, BCRL, physical activity, exercise, exercise therapy, resistance training, weight lifting, aerobic exercise, Pilates, yoga, aquatic exercise, rehabilitation, compression, complete decongestive therapy, surveillance, bioimpedance spectroscopy, survivorship and oncology rehabilitation. Both American and British spellings of lymphedema/lymphoedema were used to improve retrieval.

2.3. Eligibility and synthesis. Publications were included if they were published between 2016 and 2026, available as free full text and addressed women treated for breast cancer, women at risk of BCRL, established BCRL, exercise prescription, lymphedema outcomes, shoulder or limb function, symptom burden, patient-reported outcomes, prospective surveillance, compression during activity or survivorship physical activity guidance. Studies focusing exclusively on surgical lymphatic reconstruction, pharmacological therapy, non-breast-cancer lymphedema, case reports without relevance to exercise, conference abstracts, non-English publications or articles without accessible full text were excluded. The final synthesis included 31 freely available full-text publications [1-31].

2.4. Appraisal approach. Because this is not a systematic review, duplicate screening, formal risk-of-bias scoring and meta-analysis were not performed. Findings were interpreted according to study type, population, intervention, outcomes and practical transferability. Higher confidence was assigned to findings supported by multiple reviews, guidelines, prospective

studies and trials, whereas small or single-modality studies were used cautiously to identify emerging directions.

2.5. Terminology. The term prevention is used cautiously. Exercise should not be presented as a guaranteed preventive intervention or cure for BCRL. A more accurate interpretation is that progressive physical activity is safe for most clinically stable women, can support risk reduction and early detection, and may help preserve strength, function, body composition and confidence.

3. Results of the narrative review

3.1. BCRL: definition, risk factors and assessment

BCRL is a secondary lymphedema caused by impaired lymph transport after breast cancer therapy. Surgery and radiotherapy may reduce lymphatic transport capacity, and persistent stasis can promote inflammation, adipose deposition and fibrosis. This dynamic process explains why early fluid-dominant changes may be more reversible than later fibrotic stages [1, 11].

Assessment should combine symptoms, clinical examination, limb measurement, tissue quality, skin condition, range of motion, strength and patient goals. Tape circumference, perometry, water displacement and bioimpedance spectroscopy each have advantages and limitations [13, 14]. Limb volume can fluctuate with heat, activity, hydration, weight change and measurement error; therefore, patient-reported heaviness, tightness, pain and functional limitation should not be ignored even when objective changes are small [1, 2, 13].

Risk stratification matters for exercise planning. Patients after sentinel node biopsy and uncomplicated surgery usually require less intensive monitoring than patients after axillary lymph node dissection, regional nodal irradiation, recurrent cellulitis or established stage II BCRL. However, risk stratification should guide surveillance and progression, not permanent activity prohibition [1, 2, 3, 12].

3.2. From restriction to progressive loading

Older precautionary advice discouraged heavy lifting, repetitive upper-limb work and vigorous sport. Contemporary reviews, guidelines and consensus statements now support monitored participation in physical activity and reject blanket prohibitions against upper-limb exercise [4, 5, 6, 11, 18, 19]. The important distinction is between sudden unaccustomed overload and planned progressive loading.

Progressive loading allows tissue adaptation, builds confidence and increases functional reserve. It does not mean that all loads are appropriate for all patients. Exercise should begin from the current safe baseline and should be modified during infection, unhealed wounds, severe pain, unstable swelling, major treatment toxicity or relevant comorbidity [6, 11, 18].

3.3. Resistance training

Resistance training has the strongest evidence among exercise modalities for BCRL. Systematic reviews and practice guidance indicate that resistance exercise is safe for clinically stable women with or at risk of BCRL when introduced with low or moderate loads, careful technique, gradual progression and symptom monitoring [4, 5, 7, 8]. Its clearest benefits are improved strength, function, confidence and participation; reduction in limb volume is less consistent [5, 7, 8].

Resistance training should be understood as a graded intervention rather than a single fixed prescription. Programmes differ in frequency, load, repetitions, supervision, compression use and baseline lymphedema status. Shamsesfandabadi et al. reported that supervised dose-escalated resistance training was not associated with subjective or clinical worsening of lymphedema and was accompanied by favourable changes in bioimpedance-derived fluid-balance metrics and upper-extremity lean mass [9]. Because this was a single-arm cohort study, it supports feasibility and safety under supervision rather than replacing randomised evidence.

Practical progression should increase only one or two variables at a time, such as load, repetitions, sets, range or exercise complexity. Progression is appropriate when the previous dose is tolerated without persistent swelling, heaviness, pain, skin changes or garment intolerance. Delayed-onset muscle soreness alone is not lymphedema, but soreness combined with persistent swelling or tightness should prompt load reduction and reassessment.

3.4. Aerobic and combined exercise

Aerobic exercise is less directly studied for limb volume than resistance training, but it is central to survivorship health. Walking, cycling, low-impact aerobic exercise and swimming when skin integrity is adequate may improve cardiorespiratory fitness, fatigue, mood, body composition and cardiometabolic risk. These outcomes are important because higher body mass index and treatment-related weight gain are associated with BCRL risk and progression [1, 3, 16, 17].

Combined aerobic and resistance programmes may be especially useful because BCRL often coexists with fatigue, shoulder dysfunction, neuropathy, arthralgia, anxiety and reduced confidence. Contemporary reviews generally support exercise safety and potential benefits for symptoms and quality of life, even when limb-volume changes are modest or inconsistent [7, 8, 10]. Therefore, clinical success should not be judged only by arm volume. Returning to work, carrying groceries, sleeping better or reporting less heaviness may represent meaningful rehabilitation.

3.5. Early mobility and rehabilitation after surgery

Postoperative rehabilitation should avoid both early overloading and prolonged immobilisation. Gentle breathing, hand and elbow mobility, posture, shoulder range of motion and gradual return to daily activities are typically introduced before loaded strengthening. Progression should follow wound healing, pain control, drain status and surgical instructions [6, 18, 19].

Complete decongestive therapy remains important for selected patients with established BCRL and may include manual lymphatic drainage, compression, exercise, skin care and education [11, 20]. Active rehabilitation should not be replaced by passive techniques alone. Instead, therapist-delivered interventions, compression and self-management should support safe return to movement and daily function [6, 11, 18, 20].

3.6. Yoga, Pilates and aquatic exercise

Yoga and related mind-body modalities combine movement, breathing, relaxation, posture and body awareness. Reviews describe a generally favourable safety profile, but protocols are heterogeneous and limb-volume outcomes are inconsistent [21, 22]. Yoga should therefore be

presented as an adjunct for symptoms, mobility, relaxation and body confidence rather than as a primary volume-reduction treatment.

Pilates-based rehabilitation may be useful for selected patients because it emphasises controlled movement, breathing, trunk and scapular control, posture and gradual strengthening. Şener et al. reported favourable effects on lymphedema-related outcomes, upper-extremity function, grip strength, quality of life and social appearance anxiety [23]. The evidence remains promising rather than definitive.

Aquatic exercise is attractive because hydrostatic pressure may assist edema control while reducing joint loading. Studies suggest potential benefits for limb volume, pain, shoulder mobility and quality of life [24, 25]. Programmes require intact skin, pool hygiene and caution during radiation dermatitis, open wounds, fungal infection, immunosuppression or acute inflammatory symptoms.

3.7. Compression, skin care and surveillance

Compression garments are commonly used for established BCRL and may improve comfort and confidence during exercise for women who already use a well-fitted garment. However, current evidence does not prove that every survivor at risk must wear compression during all activity. Compression decisions should be individualised according to swelling status, symptoms, garment fit and specialist assessment [11, 15, 26].

Skin care remains essential because cellulitis can worsen lymphedema. Patients should protect the skin from cuts, burns, insect bites and fungal infection; moisturise dry skin; clean minor injuries; and seek care for redness, warmth, fever, rapidly increasing swelling or pain [11, 18, 19]. The message should be positive: the arm is usable, but an active limb deserves ordinary protection and early attention to infection risk.

Prospective surveillance can support exercise by establishing baseline measurements, detecting early fluid changes and triggering early intervention. Bioimpedance spectroscopy is often used to identify subclinical extracellular fluid changes, and clinical guidance supports baseline and follow-up assessment in appropriate risk groups [14, 28, 29]. Surveillance should include both objective measures and patient-reported symptoms.

3.8. Practical exercise prescription and red flags

Safe exercise prescription is based on screening, individualisation, gradual progression, monitoring and communication. Screening should identify active infection, uncontrolled pain, unhealed wounds, unstable cardiopulmonary disease, severe anaemia, bone metastases affecting loading, neuropathy, balance impairment and severe fatigue. Individualisation should consider lymphedema stage, previous activity, treatment phase, comorbidities, preferences and access to supervision [4, 6, 16, 18].

Warning signs include persistent swelling, new heaviness or tightness lasting more than 24 hours after exercise, new pain, reduced range of motion, skin redness, warmth, fever or garment intolerance. A symptom flare should lead to dose reduction, technique review, garment assessment, skin assessment and referral when necessary. This approach avoids both extremes: ignoring symptoms and forbidding activity.

3.9. Implementation, patient education and psychosocial outcomes

Many survivors remain inactive because of fear of lymphedema, fatigue, pain, limited time, cost, lack of referral and inconsistent clinician messages. A systematic rapid review across cancer types showed that barriers and preferences vary by cancer type and treatment stage, which supports the need for flexible and patient-centred exercise guidance [27].

Communication matters. Statements such as never lift more than five pounds are easy to remember but are not evidence-based for most survivors. More useful counselling is principle-based: use the arm, start low, progress slowly, avoid sudden unaccustomed spikes in load, monitor persistent symptoms, protect the skin and seek help early if swelling changes [4, 6, 11, 18, 19]. Exercise also functions as behavioural exposure by helping survivors test and rebuild confidence in the affected limb.

Nursing-led education, early symptom recognition, self-management support and multidisciplinary collaboration are increasingly recognised as part of BCRL care [31]. Exercise professionals should understand BCRL signs, compression principles, skin care, cancer-related

fatigue, treatment side effects and red flags. Specialist services are necessary for complex cases, while community programmes are necessary for long-term adherence.

3.10. Evidence synthesis

Across contemporary literature published from 2016 to 2026, the most consistent finding is that exercise is safe when progressive, individualised and supervised or well instructed. Resistance training has the strongest evidence for safety and functional benefit. Aerobic, yoga, Pilates, aquatic and combined interventions are generally safe but show more heterogeneous effects on limb volume and symptoms [4, 5, 6, 7, 8, 10].

The evidence base should be interpreted with clinical humility. Most trials enrol medically stable volunteers who are willing to exercise; results may not fully generalise to patients with severe uncontrolled BCRL, recurrent cellulitis, metastatic disease, severe comorbidity or major social barriers. Nevertheless, the absence of evidence for harm in well-designed exercise programmes is important because long-term avoidance has known consequences for strength, fitness, fatigue, employment, mood and independence.

Table 1. Symptom-guided exercise prescription model for women with or at risk of breast cancer-related lymphedema.

Clinical situation	Recommended exercise	Progression and monitoring	When to refer or pause progression
At risk, no established BCRL	Walking or other aerobic activity, early shoulder mobility after surgery, and gradual resistance training after wound healing.	Start below current tolerance; increase one variable at a time; monitor persistent heaviness, tightness, swelling, pain and range of motion.	Refer for new persistent swelling, unexplained heaviness, infection signs, substantial shoulder limitation or uncertainty about baseline measurements.
Stable mild BCRL	Progressive resistance and aerobic exercise; mobility and functional strengthening; use	Progress from the stable baseline; review garment fit, technique and recovery; repeat the	Pause progression and reassess if symptoms persist beyond 24 hours, garment fit changes,

	prescribed compression during activity if comfortable and clinically indicated.	previous tolerated dose before increasing load.	skin irritation occurs or swelling increases.
Unstable swelling, recurrent cellulitis or complex BCRL	Specialist lymphedema assessment before progression; gentle mobility may continue if medically safe.	Do not increase load during acute change; prioritise infection management, compression review and clinical evaluation.	Urgent referral for redness, warmth, fever, rapidly increasing swelling, severe pain, suspected thrombosis or possible recurrence signs.
Postoperative or active treatment phase	Breathing, hand and elbow mobility, posture, gentle shoulder range and short walking bouts; loaded strengthening only after medical clearance.	Coordinate with wound status, drains, pain, radiation dermatitis, anaemia, neuropathy and fatigue; progress conservatively.	Refer for unhealed wounds, severe pain, marked range restriction, wound complications, infection signs or inability to resume basic function.
Return to work, sport or domestic loading	Task-specific graded exposure for carrying, pushing, pulling, gardening, swimming, gym training or occupational demands.	Build capacity before large tasks; distribute loads, use breaks and skin protection; track symptoms after repetitive work.	Reassess if repeated tasks provoke swelling, pain, garment intolerance, loss of motion or avoidance due to fear.

4. Discussion

This narrative review supports a clear shift in clinical thinking: BCRL should not be managed by long-term avoidance of arm use. The most defensible practical message is not unrestricted activity for every patient, but graded, individualised and monitored exercise for clinically stable women, with specialist input for unstable or complicated cases. This position is supported by contemporary systematic reviews, prospective evidence, guideline statements and exercise-oncology consensus guidance [4, 5, 6, 7, 8, 10, 16, 18].

For a sport and health journal, the topic is directly relevant because BCRL care concerns safe return to movement, health-oriented exercise, recreational sport, supervised training, active self-management and quality of life after cancer treatment. Rehabilitation should be understood as a bridge between oncology care and long-term active living, not only as a method of limb-volume control.

The relationship between exercise and limb volume requires careful interpretation. Many programmes stabilise limb volume while strength, symptoms, function or quality of life improve. This should not be considered failure. A programme that allows a survivor to lift a child, return to work, improve shoulder mobility, tolerate daily tasks or reduce fear is clinically valuable even if arm circumference is unchanged. Core outcome work also supports combining objective measures with patient-relevant outcomes [30].

4.1. Relationship with guidelines and consensus statements

The American College of Sports Medicine roundtable concluded that cancer survivors can safely engage in exercise sufficient to improve fitness, function and quality of life, including resistance training among those with or at risk of BCRL when appropriately prescribed [4]. ASCO guidance supports aerobic and resistance exercise during active cancer treatment with curative intent, and the American Cancer Society emphasises physical activity, healthy weight and diet as survivorship behaviours [16, 17]. The International Society of Lymphology and NICE evidence review place exercise within broader conservative management and education rather than outside standard care [11, 18].

4.2. Clinical practice recommendations

A practical pathway should begin before or soon after treatment with education and baseline assessment when feasible. After surgery, survivors should perform gentle range-of-motion activity according to surgical guidance. After healing, they should progress gradually towards aerobic and resistance exercise. For resistance training, supervised or well-instructed sessions using low loads, slow progression and technique monitoring are a realistic starting point [4, 5, 6, 18].

For stable established BCRL, exercise should be coordinated with compression and self-management. If a prescribed garment is already used, wearing it during exercise may be

reasonable unless it causes discomfort or constriction. If no garment has been prescribed and symptoms are absent, routine garment use for every exercise session is not automatically required [11, 15, 26].

4.3. Practical recommendations for clinical translation

In applied practice, six recommendations are most important. First, routine long-term prohibition of arm use should be avoided. Second, exercise should start from the survivor's current capacity and progress gradually, usually by changing only one variable at a time. Third, persistent heaviness, swelling, pain, skin changes, reduced range of motion and garment intolerance should be monitored. Fourth, compression should be used when clinically indicated rather than prescribed automatically for every survivor. Fifth, exercise should be integrated with surveillance, skin care, weight-management support and education. Sixth, acute infection, rapidly increasing swelling, unhealed wounds, severe pain, fever or unexplained sudden change should trigger medical or lymphedema-specialist assessment before progression.

4.4. Equity and implementation

Not all survivors have access to certified lymphedema therapists, oncology physiotherapists, safe exercise spaces or compression garments. Home-based walking, resistance bands, body-weight exercises and simple written plans can reduce barriers. Tele-rehabilitation, culturally appropriate materials, group programmes and collaboration with community fitness professionals may extend care, but complex cases still need specialist referral pathways [27, 31].

4.5. Research gaps

Uncertainties remain regarding the optimal dose of resistance training, high-intensity progression, compression during exercise, long-term adherence, digital delivery and effects in women with advanced tissue fibrosis, recurrent cellulitis, metastatic disease or substantial comorbidity. Yoga, Pilates and aquatic exercise are promising but require larger trials with standardised outcomes [21, 22, 23, 24, 25, 30]. Implementation research should test how to reduce fear-based messages and embed exercise referral into routine breast cancer pathways.

4.6. Strengths and limitations of this review

A strength of this review is its integration of systematic reviews, guidelines, prospective surveillance evidence and practical rehabilitation reasoning. Another strength is the restriction of the final reference base to free full-text publications from 2016 to 2026, which improves accessibility for readers. The main limitation is that this is not a systematic review with exhaustive search, duplicate screening or formal risk-of-bias scoring. Older landmark trials and some paywalled articles were not cited directly but were considered through contemporary reviews and guidelines.

5. Conclusions

Breast cancer-related lymphedema is a chronic survivorship problem that can impair physical function, symptoms, body image, work capacity and quality of life. Contemporary evidence indicates that progressive, individualised and monitored exercise is safe for most clinically stable women with or at risk of BCRL and should be included in risk-reduction, surveillance and rehabilitation pathways. This recommendation does not apply to acute infection, unstable swelling, unhealed wounds or severe uncontrolled symptoms without appropriate clinical assessment.

The strongest evidence supports slowly progressive resistance training, particularly when introduced with appropriate supervision, symptom monitoring and gradual progression. Aerobic exercise, mobility work, yoga, Pilates-based rehabilitation, aquatic exercise and combined programmes are also generally safe and may improve symptoms, shoulder function, fatigue, fitness, body composition, confidence and quality of life, although evidence for optimal dose and volume reduction is less consistent across these modalities.

Exercise prescription for BCRL should begin from the patient's current capacity, progress gradually, avoid sudden unaccustomed load spikes, monitor swelling and skin changes, use compression when clinically indicated, protect skin integrity and refer early for new, worsening or inflammatory symptoms. Physical activity should be treated as a core element of breast cancer survivorship and lymphedema care, integrated with education, surveillance, skin care, weight management and access to lymphedema-trained professionals. In practical terms, exercise should be framed as a controlled therapeutic exposure that restores function and confidence, not as a threat to the affected limb.

Disclosure

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All authors have read and agreed with the published version of the manuscript.

Funding

No external funding was received.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

Not applicable.

Conflicts of Interest

The authors declare no conflict of interest.

Declaration of the use of generative AI and AI-assisted technologies in the writing process.

In preparing this work, the authors used OpenAI ChatGPT for the purpose of improving language and readability, text formatting, and verification of bibliographic style. After using this tool, the authors reviewed and edited the content as needed and accept full responsibility for the substantive content of the publication.

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