



QUALITY IN SPORT

eISSN 2450-3118 · Open Access · Peer-reviewed

apcz.umk.pl/QS Nicolaus Copernicus University in Toruń



ŚWIT, Weronika, CICHON, Bartosz, ZACHWIEJA, Krzysztof, WODNICKI, Jakub, PROKOP, Krzysztof, WOJTAROWICZ, Maciej and DĄBROWSKI, Patryk. Exercise as Supportive Care During Breast Cancer Treatment: A Narrative Review of Strategies to Reduce Cancer-Related Fatigue and Improve Quality of Life. *Quality in Sport*. 2026;75:75639. <https://doi.org/10.12775/QS.2026.75.75639>

ARTICLE TIMELINE

Received: 24.08.2026. Accepted: 18.09.2026. Published: 22.09.2026.

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.

OPEN ACCESS · CC BY-NC-SA 4.0 This article is published with open access under the License Open Journal Systems of Nicolaus Copernicus University in Toruń, Poland, and is distributed under the terms of the Creative Commons Attribution Non-commercial Share Alike License (<http://creativecommons.org/licenses/by-nc-sa/4.0/>), which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the work is properly cited. The authors declare no conflict of interest regarding the publication of this paper.

Exercise as Supportive Care During Breast Cancer Treatment: A Narrative Review of Strategies to Reduce Cancer-Related Fatigue and Improve Quality of Life

Weronika Świt, Bartosz Cichon, Krzysztof Zachwieja, Jakub Wodnicki, Krzysztof Prokop, Maciej Wojtarowicz, Patryk Dąbrowski

Weronika Świt

The University Hospital in Krakow, Macieja Jakubowskiego 2, 30-688 Kraków

ORCID: <https://orcid.org/0009-0000-1783-6013>

E-mail: weronikajuliaswit@gmail.com

Bartosz Cichon

The University Hospital in Krakow, Macieja Jakubowskiego 2, 30-688 Kraków

ORCID: <https://orcid.org/0009-0000-0513-337X>

E-mail: Bartexcichon@gmail.com

Krzysztof Zachwieja

The University Hospital in Krakow, Macieja Jakubowskiego 2, 30-688 Kraków

ORCID: <https://orcid.org/0009-0007-8851-053X>

E-mail: krzysiekz2413@gmail.com

Jakub Wodnicki

The University Hospital in Krakow, Macieja Jakubowskiego 2, 30-688 Kraków

ORCID: <https://orcid.org/0009-0007-9802-9299>

E-mail: jakubwodnicki2@gmail.com

Krzysztof Prokop

The University Hospital in Krakow, Macieja Jakubowskiego 2, 30-688 Kraków

ORCID: <https://orcid.org/0009-0001-0653-3305>

E-mail: Krzysztof.prokop@protonmail.com

Maciej Wojtarowicz

The University Hospital in Krakow, Macieja Jakubowskiego 2, 30-688 Kraków

ORCID: <https://orcid.org/0009-0004-9883-5213>

E-mail: maciejkov@gmail.com

Patryk Dąbrowski

The University Hospital in Krakow, Macieja Jakubowskiego 2, 30-688 Kraków

ORCID: <https://orcid.org/0009-0004-5388-8581>

E-mail: patrykdabrowskiuj@gmail.com

Corresponding author:**Patryk Dąbrowski**

The University Hospital in Krakow, Macieja Jakubowskiego 2, 30-688 Kraków

ORCID: <https://orcid.org/0009-0004-5388-8581>

E-mail: patrykdabrowskiuj@gmail.com

Abstract

Background. Cancer-related fatigue (CRF) and deterioration in health-related quality of life (HRQoL) are frequent consequences of breast cancer treatment and may compromise physical functioning and daily activity. Exercise has therefore become an important component of supportive oncology.

Aim. To critically evaluate exercise interventions used during active breast cancer treatment, with emphasis on CRF and HRQoL.

Material and methods. A targeted narrative review of PubMed-indexed studies and major clinical guidelines was undertaken, prioritizing guidelines, systematic reviews, meta-analyses, and randomized controlled trials involving women receiving chemotherapy or radiotherapy.

Results. Exercise reduces CRF, with evidence supporting aerobic, resistance, and combined training. Supervised combined programs often produce larger or more consistent benefits, although effective home-based interventions have also been demonstrated. Effects on HRQoL are positive overall but less uniform than effects on fatigue and physical fitness. Mechanistic studies may suggest preservation of skeletal-muscle function and modulation of inflammatory pathways. Evidence that exercise improves tumour response or survival during treatment remains insufficient.

Conclusions. Individualized aerobic and resistance exercise represents an evidence-based supportive intervention during breast cancer treatment, particularly for CRF and functional deterioration.

Key words: *breast cancer; exercise; cancer-related fatigue; quality of life; chemotherapy; radiotherapy; supportive care*

Introduction

Modern multimodal treatment has significantly improved the outcomes of breast cancer patients, but standard interventions such as surgery, chemotherapy, radiotherapy, and endocrine therapy can cause numerous side effects. Among treatment-related symptoms, cancer-related fatigue (CRF) is particularly important because it differs from normal tiredness: it may be disproportionate to recent activity, inadequately relieved by rest, and accompanied by impaired concentration, reduced motivation, and decreased physical functioning. Cancer-related fatigue may manifest prior to treatment initiation, intensify during systemic therapy or radiotherapy, and persist well beyond the completion of treatment. Its biological basis is multifactorial, involving treatment-related tissue injury, inflammatory signalling, neuroendocrine alterations, changes in skeletal muscle, sleep disturbance, psychological distress, and behavioral deconditioning rather than a single causal pathway. [4,5] Fatigue and lack of physical activity can reinforce one another. A patient who reduces activity in response to treatment toxicity may lose cardiorespiratory capacity and muscle strength, making ordinary activities more demanding and potentially amplifying perceptions of exhaustion. Exercise is therefore conceptually different from simply advising a fatigued patient to “remain active.” Structured exercise provides a physiological stimulus intended to preserve or restore

capacity despite ongoing treatment. Evidence accumulated over the past two decades has led clinical recommendations to change from routine bed rest to appropriately individualized physical activity. The American Society of Clinical Oncology (ASCO) recommends aerobic and resistance exercise during active treatment with curative intent, while contemporary CRF guidelines recommend exercise as a first-line non-pharmacological strategy during treatment. [1,2] Exercise interventions in breast cancer are varied. Programs have included continuous aerobic training, interval exercise, progressive resistance training, combined aerobic-resistance programs, supervised group sessions, home-based walking or resistance programs, and high-intensity interval training (HIIT). These approaches should not be considered interchangeable. They have different physiological targets, and treatment-related symptoms, baseline fitness, comorbidities, access to supervision, and patient preference can substantially modify feasibility and adherence. Outcomes measured in exercise trials range from subjective fatigue and HRQoL to cardiorespiratory fitness, muscle strength, inflammatory biomarkers, chemotherapy delivery, and tumor response. Improvements in physical fitness or biomarkers are clinically relevant, but they cannot automatically be interpreted as evidence of improved cancer control. This distinction is important because the role of exercise during cancer treatment extends beyond its well-established supportive benefits. Current guidelines support exercise for reducing fatigue and improving physical function, strength, and selected patient-reported outcomes, but there is still insufficient evidence to conclude that it reduces recurrence or mortality. [1,3] The aim of this review was to evaluate the role of physical exercise as supportive care during active breast cancer treatment, focusing principally on methods that reduce CRF and preserve or improve HRQoL.

Research Materials and Methods

A targeted narrative literature review was undertaken using PubMed-indexed publications and major oncology/exercise guidelines accessed in August 2026. Search concepts combined terms relating to *breast cancer, exercise, physical activity, aerobic training, resistance training, high-intensity interval training, chemotherapy, radiotherapy, neoadjuvant treatment, cancer-related fatigue, quality of life, randomized trial, systematic review, meta-analysis, and guideline*. Searches were not constrained by a prespecified publication period. Clinical-practice guidelines and consensus statements were prioritized for recommendations; systematic reviews and meta-analyses of randomized trials were used to characterize overall intervention effects; and original randomized trials were prioritized when discussing specific interventions or quantitative results. Mechanistic studies nested within randomized trials were included when they directly evaluated physiological pathways potentially relevant to fatigue.

Recent neoadjuvant trials were considered when evaluating whether supportive-care benefits extend to treatment delivery or tumor-related outcomes. The review focused on adult women with breast cancer undergoing active systemic treatment or radiotherapy. No PRISMA screening procedure, prospective protocol, formal study-count flow diagram, or independent risk-of-bias scoring was performed—the work should be interpreted as a critical narrative review rather than a systematic review.

Results

Evidence supporting exercise for cancer-related fatigue

Guideline-level evidence supports exercise as one of the most established non-pharmacological interventions for CRF. The 2022 ASCO guideline found that exercise during active cancer treatment improves fatigue, cardiorespiratory fitness, physical functioning, strength, and selected patient-reported outcomes, while serious exercise-related harms were uncommon in the evaluated trials. Aerobic and resistance exercise was strongly recommended during treatment, but the underlying evidence was rated moderate to low because of heterogeneity in populations and interventions. [1] The 2024 ASCO–Society for Integrative Oncology fatigue guideline also recommends aerobic exercise, resistance exercise, or their combination during treatment, emphasizing tailoring to ability, safety, access, and patient preference. [2] Mustian et al. analysed 113 randomized trials including 11,525 participants with different cancer types and found a weighted effect size of 0.30 (95% CI 0.25–0.36) for the effect of exercise on cancer-related fatigue. Exercise and psychological interventions produced greater improvements than the pharmacological interventions evaluated in that meta-analysis. [6] Although this analysis was not limited to breast cancer or to active treatment, its conclusions are consistent with breast-cancer-specific evidence. A meta-analysis of exercise during adjuvant chemotherapy and radiotherapy included 20 randomized controlled trials and 1,793 women with breast cancer. Exercise was associated with reduced fatigue compared with control conditions (standardized mean difference [SMD] -0.46 , 95% CI -0.66 to -0.27). The chemotherapy subgroup had a significant benefit (SMD -0.38 , 95% CI -0.55 to -0.20). Supervised combined resistance and aerobic exercise produced the largest subgroup estimate, although the wide confidence interval around that estimate indicates substantial imprecision and cautions against declaring one modality definitively superior. [7] Supervised exercise may provide additional benefits, but non-supervised programs can also reduce fatigue. A 2022 systematic review and meta-analysis which included 31 studies and 2,964 women reported reductions in fatigue with both supervised (SMD -0.74 , 95% CI -0.99 to -0.48) and non-supervised programs (SMD -0.46 , 95% CI -0.64 to -0.28). There was no

statistically significant overall difference between these categories, but supervised programs showed larger effects in a short-term subgroup analysis. [8] These findings suggest that supervision can promote adherence, progression, and adequate exercise dose, but a clinically useful program does not necessarily need continuous facility-based supervision.

Aerobic, resistance, and combined training during chemotherapy

Randomized chemotherapy trials show why aggregate meta-analytic results should be evaluated in the context of individual studies. In the START trial, Courneya et al. randomized 242 women beginning adjuvant chemotherapy to supervised aerobic exercise, supervised resistance exercise, or usual care for a median of 17 weeks. Neither exercise arm had a significant effect on the primary cancer-specific HRQoL end point or fatigue compared with usual care. Aerobic training was associated with improvements in aerobic fitness and self-esteem, whereas resistance training enhanced muscular strength, lean body mass, and self-esteem. Exercise was not associated with an increased risk of lymphedema or serious adverse events [10]. This trial showed a clear physiological benefit despite a neutral primary HRQoL result, illustrating why improved fitness does not necessarily correspond with improved global patient-reported well-being. The PACES trial provided stronger evidence for symptom protection during chemotherapy. Among 230 patients treated with adjuvant chemotherapy, participation in either a low-intensity home-based activity program or a supervised moderate- to high-intensity combined exercise program was associated with less deterioration in cardiorespiratory fitness and physical functioning than usual care. The supervised OnTrack intervention also resulted in improved muscle-strength outcomes and reduced physical fatigue. Both exercise groups also reported less nausea, vomiting, and pain. [11] The observation that the higher-intensity supervised program produced the most benefits does not prove that vigorous exercise is universally necessary. It shows that patients who can tolerate structured combined training can maintain multiple domains of function during chemotherapy. Dose-escalation evidence is more complex. The CARE trial randomized 301 women receiving chemotherapy to standard aerobic exercise of approximately 25–30 minutes three times weekly, higher-volume aerobic exercise of 50–60 minutes three times weekly, or a similarly long combined aerobic-resistance program. Neither higher-volume intervention was superior to standard aerobic exercise for the prespecified primary physical-function endpoint. Secondary analyses suggested benefits of higher aerobic volume for selected physical outcomes and of combined training for muscular strength, but these comparisons were not uniformly adjusted for multiplicity. [12] The study results therefore contradict the simple assumption that more exercise leads to proportionally greater symptom relief. Resistance

exercise alone may be particularly useful where maintaining strength and physical function is a priority. In a randomized trial of 101 women starting chemotherapy, twice-weekly supervised resistance training was compared with an equally supervised relaxation control. Total and physical fatigue worsened in the control condition, while resistance exercise mitigated this deterioration; between-group effects were more apparent among participants without severe baseline depression. Improvements in role and social functioning were also reported. [13] Because both groups received supervised group contact, this study provides useful evidence that the benefit was not explained by attention or social interaction alone. The OptiTrain trial extended this literature to high-intensity interval training. In a randomized controlled trial, 240 women receiving chemotherapy were randomly assigned to 16 weeks of resistance training plus HIIT, moderate-intensity aerobic training plus HIIT, or usual care. Resistance-HIIT was significantly more effective than usual care in reducing total, behavioral/daily-life and sensory/physical fatigue. [14] Physiological tests from the same trial showed that cardiorespiratory fitness and muscle strength are well maintained with structured training, in particular. [15] At 12 months after chemotherapy initiation, several differences in fatigue, symptom burden, and strength were still detectable, although the magnitude and pattern of effects varied according to outcome and training regimen. [17] Collectively, chemotherapy trials support aerobic, resistance, and combined exercise rather than a single uniquely effective protocol. The benefit of combined programs is that they can address both aerobic capacity and muscular strength, and they often achieve positive fatigue outcomes. High-intensity intervals can be feasible in selected patients under supervision, but evidence does not support prescribing HIIT to every woman undergoing chemotherapy. The goal of treatment should be to maintain function and control symptoms at a dose that can be used consistently despite variable treatment toxicity.

Exercise during radiotherapy

Radiotherapy provides a different clinical context because severe systemic toxicity is usually less pronounced than during cytotoxic chemotherapy, but cumulative fatigue often develops during the treatment course. Resistance exercise has been compared with active psychosocial controls, which strengthens causal interpretation. In the BEST trial, 160 women with stage 0–III breast cancer were randomized to 12 weeks of progressive resistance exercise or group-based relaxation during adjuvant radiotherapy. Resistance training significantly improved general fatigue, especially physical fatigue (between-group mean difference -0.8 , 95% CI -1.5 to -0.2), while role functioning and pain also favored exercise. There was no significant difference in cognitive and affective fatigue. [18] Home-based intervention is also possible.

Mavropalias et al. randomized 106 women commencing radiotherapy to usual care or a 12-week home-based resistance and aerobic program. The prescribed exercise volume was relatively low, and 89 participants completed the study. Exercise was associated with faster recovery of CRF during and after radiotherapy and higher HRQoL at radiotherapy completion, without exercise-related adverse events. [20] These data are clinically relevant for patients who cannot attend supervised programs because of geographic, financial, occupational, or caregiving constraints. Evidence from radiotherapy studies is generally positive for fatigue but less certain for global HRQoL. Consequently, fatigue should be considered as the more consistently responsive patient-reported endpoint.

Quality of life: benefit with substantial heterogeneity

The effect of exercise on HRQoL is positive but more variable than its effect on fatigue or physical fitness. HRQoL includes physical, emotional, social, role, and symptom domains; an intervention that meaningfully improves strength or fatigue may only have a modest impact in a global HRQoL score. This phenomenon is demonstrated in START, where physiologic outcomes improved but the primary cancer-specific HRQoL endpoint did not. [10]. The pragmatic trial by Mutrie et al. similarly found no significant intervention effect on the primary general FACT-G outcome after a 12-week supervised group program, but breast-cancer-specific QoL, physical activity, walking performance, shoulder mobility, and positive mood improved. [24] However, the direction of effect at the synthesis level is encouraging. A network meta-analysis of 18 randomized trials and 1,539 women receiving chemotherapy found significant improvement in overall HRQoL with both combined and endurance-based exercise relative to control interventions (effect size 0.41, 95% CI 0.15–0.68 for each category). [9] The network rankings should be interpreted with caution, as they are based on indirect and direct comparisons, categorization of interventions and the assumption that trials are comparable. This finding is consistent with the broader interpretation that exercise is more likely to preserve HRQoL when programs achieve sufficient aerobic or combined training stimulus.

Biological pathways potentially linking exercise with fatigue

Exercise may influence CRF through several interacting physiological mechanisms rather than a single pathway. Chemotherapy can induce loss of skeletal-muscle oxidative capacity and structural deterioration, potentially increasing the relative effort required for normal activity. A muscle-biopsy substudy within OptiTrain evaluated 23 women and found decreases in muscle fiber area, capillarization, and markers of mitochondrial function in usual-care participants, while exercise prevented some of these changes. Change in citrate-

synthase activity was correlated with self-reported fatigue [16]. Because this mechanistic sample was small, the findings establish biological plausibility rather than proving that muscle preservation fully mediates clinical fatigue reduction. Inflammation may be another factor involved in cancer-related fatigue. In the BEST radiotherapy study, progressive resistance exercise was associated with stable IL-6 levels, while IL-6 increased in the control group. Changes in IL-6 and the IL-6/IL-1 receptor antagonist ratio partly explained the later improvements in physical fatigue and pain, although their overall contribution was small. [19] This suggests that inflammation is only one of several mechanisms involved in CRF. Other factors, including psychological distress, sleep problems, anemia, treatment-related toxicity, pain, autonomic dysfunction, baseline physical activity, and changes in skeletal muscle, may also contribute [5].

Exercise prescription, individualization, and safety

Consensus recommendations can be used as a general guide rather than a strict exercise target. The American College of Sports Medicine suggests that moderate-intensity aerobic activity performed approximately three times weekly for about 30 minutes can reduce fatigue. Resistance training around twice a week and combined aerobic and resistance programs may also be beneficial. For broader cancer-related outcomes, programs lasting at least 8–12 weeks are commonly supported. Resistance components typically use progressive loading rather than fixed low-intensity movement. [3] The clinical principle is therefore to prescribe an adequate training while adapting it to treatment status. During chemotherapy, symptom burden can change across treatment cycles; the exercise plan may require temporary reductions in volume or intensity when nausea, infection, haematological toxicity, pain, or profound fatigue are present. The appropriate program also depends on previous activity level, age, cardiovascular and musculoskeletal comorbidity, surgical recovery, neuropathy, and patient preference. ASCO specifically emphasizes individualized aerobic and resistance exercise rather than a universal protocol. [1,2] Safety data in early-stage breast cancer are generally reassuring. Major randomized trials have reported high completion rates and few serious intervention-related adverse events, including trials including progressive resistance training. [10,18,20] This evidence applies most accurately to adequately screened patients participating in structured programs and should not be uncritically generalized to individuals with unstable medical complications or advanced disease. Exercise prescription remains a component of supportive clinical care and should be tailored to the individual's health status.

Treatment delivery and cancer-related outcomes

An important question is whether exercise can improve chemotherapy delivery or anticancer efficacy. Some earlier trials suggested favorable chemotherapy-completion outcomes, including the resistance arm of START and the supervised OnTrack program in PACES. [10,11] However, chemotherapy completion was usually secondary rather than primary, and results have not been fully consistent across studies. ASCO consequently judged the evidence insufficient to recommend exercise specifically for improving treatment completion or cancer control. [1] In the BENEFIT trial, 180 women were assigned to supervised resistance exercise, supervised aerobic exercise, or a wait-list control during neoadjuvant chemotherapy. The primary outcome - change in tumor size - was not significantly different in the overall study population, although exploratory subgroup analyses suggested possible receptor-dependent differences. Exercise was associated with a reduced likelihood of premature chemotherapy discontinuation, but the subgroup findings regarding tumor response require independent confirmation [22]. The 2025 Neo-train trial randomized 102 patients to usual care or supervised HIIT plus progressive resistance training three times weekly during neoadjuvant chemotherapy. There was no significant difference in tumor-size reduction, radiological complete response, or pathological complete response. Exercise improved cardiorespiratory fitness and muscular strength and was associated with better chemotherapy-delivery measures and shorter hospitalization. HRQoL did not differ significantly between groups. [23] These results support exercise as a strategy for maintaining physical resilience during intensive therapy, but they do not establish an antitumor effect. A further note of caution comes from the 2026 secondary analysis of the BENEFIT trial. Among 184 randomized patients, neither aerobic nor resistance exercise performed during neoadjuvant chemotherapy showed a clear post-intervention advantage over the wait-list group for CRF or sleep. [21] This neutral result does not negate the broader evidence base, but it demonstrates that the magnitude and timing of fatigue responses depend on the population, treatment phase, comparator, baseline symptom burden, and outcome trajectory.

Discussion

The available evidence supports exercise as an effective component of supportive care during breast cancer treatment, with the most convincing benefits involving CRF, cardiorespiratory fitness, muscle strength, and maintenance of physical functioning. Fatigue findings are supported by guidelines, breast-cancer-specific meta-analyses, and multiple randomized trials. [1–3,7,8] Effects on HRQoL are positive at the pooled level but less consistent in individual

trials, partly because global QoL instruments integrate domains that may not respond synchronously to exercise. No particular exercise modality has been shown to be superior to all others. Aerobic exercise targets cardiorespiratory deconditioning. Resistance exercise preserves muscular strength and lean tissue; combined programs address both domains and frequently provide the broadest supportive effect. HIIT may induce significant physiological adaptation and fatigue reduction in specific supervised cohorts and should be considered as a training option rather than a mandatory intensity marker. The CARE trial shows that simply increasing aerobic exercise duration does not guarantee superior primary outcomes. [12] The clear advantage of supervised programs also needs qualification. Supervision can facilitate progression, adherence, symptom monitoring, and confidence, particularly in previously inactive patients. In contrast, home-based exercise has produced clinically useful improvements during both chemotherapy and radiotherapy, and meta-analysis does not establish a universal superiority of supervised delivery. [8,11,20] From a service-delivery perspective, this supports a tiered approach: higher-risk or markedly deconditioned patients may benefit most from exercise-oncology or rehabilitation supervision, whereas appropriately screened patients may use structured home-based programs with periodic professional review. A major limitation is the methodological heterogeneity. Trials use different fatigue and HRQoL instruments, exercise doses, intervention durations, treatment regimens, comparators, and eligibility criteria. Exercise studies cannot generally blind participants or trainers, and patient-reported outcomes may be affected by expectation. Some studies use usual-care controls, while others use relaxation or attention controls. It provides stronger evidence that physical rather than purely social components of an intervention are responsible for observed differences. Adherence is another source of heterogeneity because the prescribed exercise dose may differ considerably from the dose actually completed. The evidence is consistent with clinical trial results but should not be overstated. Preservation of skeletal muscle structure, oxidative capacity, and inflammatory regulation provide biologically plausible pathways through which exercise may reduce perceived exertion and fatigue [16,19]. However, these measures remain indirect outcomes. They do not prove that modulation of a specific cytokine or mitochondrial marker is necessary or sufficient for clinical benefit, nor do they demonstrate improved disease control. Recent neoadjuvant studies are particularly informative in this regard. Exercise can improve physiological reserve and may facilitate treatment delivery without necessarily changing tumour response [22,23]. Current evidence justifies recommending exercise because it can make the treatment period physically and symptomatically more manageable; it does not support promising a greater probability of

pathological complete response, reduced recurrence, or longer survival. The most important clinical implication is not that all patients should be prescribed a standardized program, but that exercise should be considered a modifiable supportive-care intervention. A reasonable starting point is moderate aerobic exercise approximately three times a week, supplemented by progressive resistance exercise approximately twice a week, at an intensity and volume adjusted to the patient's current tolerance. [3] During periods of increased treatment toxicity, maintaining regular participation may be better than striving to increase a given training load. Patient preference, availability, prior exercise experience, and symptom fluctuations influence long-term effectiveness through adherence. Future trials should use standardized CRF and HRQoL outcomes, report adherence and exercise dose in greater detail, and distinguish effects during specific systemic regimens. Clinical trials must also be sufficiently powered to evaluate treatment endpoints and clinical outcomes in cancer treatment, rather than relying on exploratory subgroup analyses. Evidence is particularly limited for patients with advanced or metastatic disease, substantial comorbidity, severe baseline fatigue, or major treatment complications.

Conclusions

Current evidence from randomized trials and systematic reviews supports exercise as an effective supportive-care intervention during active breast cancer treatment. The most consistent benefits include reduction of cancer-related fatigue and preservation or improvement of cardiorespiratory fitness, muscular strength, and physical functioning, whereas effects on health-related quality of life are more heterogeneous. Aerobic, resistance, and combined exercise can all be effective, with exercise dose and delivery best individualized according to treatment status, symptoms, baseline fitness, and patient preferences. Supervised programs may facilitate progression and symptom monitoring, although structured home-based interventions can also provide meaningful benefits. Exercise should be integrated into breast cancer supportive care but should not be considered a proven anticancer treatment, as current neoadjuvant evidence does not demonstrate consistent improvements in tumor response.

Declaration of generative AI and AI-assisted technologies in the writing process: In preparing this work, the authors used ChatGPT (OpenAI) for language editing, reference formatting, and bibliography organization. Then, the authors reviewed and edited the text when needed and accept full responsibility for the substantive content of the publication.

DISCLOSURE:**Author's contribution:**

Conceptualization: Weronika Świt

Methodology: Weronika Świt, Bartek Cichoń

Software: Patryk Dąbrowski, Weronika Świt, Jakub Wodnicki

Check: Weronika Świt, Bartek Cichoń

Formal analysis: Weronika Świt, Jakub Wodnicki

Investigation: Bartek Cichoń, Patryk Dąbrowski

Resources: Maciek Wojtarowicz

Data curation: Weronika Świt, Krzysztof Zachwieja

Writing – rough preparation: Bartek Cichoń, Krzysztof Prokop

Writing – review and editing: Maciek Wojtarowicz

Visualization: Weronika Świt, Patryk Dąbrowski

Supervision: Maciek Wojtarowicz, Weronika Świt

Project administration: Bartek Cichoń, Krzysztof Zachwieja

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

Funding Statement

The study did not receive special funding.

Institutional Review Board Statement

Not applicable

Informed Consent Statement

Not applicable

Data Availability Statement

Not applicable

Conflict of Interest Statement

The authors declare no conflicts of interest.

Acknowledgements

Not applicable

References

1. Ligibel JA, Bohlke K, May AM, Clinton SK, Demark-Wahnefried W, Gilchrist SC, Irwin ML, Late M, Mansfield S, Marshall TF, Meyerhardt JA, Thomson CA, Wood

- WA, Alfano CM. Exercise, Diet, and Weight Management During Cancer Treatment: ASCO Guideline. *J Clin Oncol*. 2022 Aug 1;40(22):2491-2507. doi: 10.1200/JCO.22.00687. Epub 2022 May 16. PMID: 35576506.
2. Bower JE, Lacchetti C, Alici Y, Barton DL, Bruner D, Canin BE, Escalante CP, Ganz PA, Garland SN, Gupta S, Jim H, Ligibel JA, Loh KP, Peppone L, Tripathy D, Yennu S, Zick S, Mustian K. Management of Fatigue in Adult Survivors of Cancer: ASCO-Society for Integrative Oncology Guideline Update. *J Clin Oncol*. 2024 Jul 10;42(20):2456-2487. doi: 10.1200/JCO.24.00541. Epub 2024 May 16. PMID: 38754041; PMCID: PMC12082589.
 3. Campbell KL, Winters-Stone KM, Wiskemann J, May AM, Schwartz AL, Courneya KS, Zucker DS, Matthews CE, Ligibel JA, Gerber LH, Morris GS, Patel AV, Hue TF, Perna FM, Schmitz KH. Exercise Guidelines for Cancer Survivors: Consensus Statement from International Multidisciplinary Roundtable. *Med Sci Sports Exerc*. 2019 Nov;51(11):2375-2390. doi: 10.1249/MSS.0000000000002116. PMID: 31626055; PMCID: PMC8576825.
 4. Fabi A, Bhargava R, Fatigoni S, Guglielmo M, Horneber M, Roila F, Weis J, Jordan K, Ripamonti CI; ESMO Guidelines Committee. Electronic address: clinicalguidelines@esmo.org. Cancer-related fatigue: ESMO Clinical Practice Guidelines for diagnosis and treatment. *Ann Oncol*. 2020 Jun;31(6):713-723. doi: 10.1016/j.annonc.2020.02.016. Epub 2020 Mar 12. PMID: 32173483.
 5. Bower JE. Cancer-related fatigue--mechanisms, risk factors, and treatments. *Nat Rev Clin Oncol*. 2014 Oct;11(10):597-609. doi: 10.1038/nrclinonc.2014.127. Epub 2014 Aug 12. PMID: 25113839; PMCID: PMC4664449.
 6. Mustian KM, Alfano CM, Heckler C, Kleckner AS, Kleckner IR, Leach CR, Mohr D, Palesh OG, Peppone LJ, Piper BF, Scarpato J, Smith T, Sprod LK, Miller SM. Comparison of Pharmaceutical, Psychological, and Exercise Treatments for Cancer-Related Fatigue: A Meta-analysis. *JAMA Oncol*. 2017 Jul 1;3(7):961-968. doi: 10.1001/jamaoncol.2016.6914. PMID: 28253393; PMCID: PMC5557289.
 7. Torres D, Jorge Koifman R, da Silva Santos S. Impact on fatigue of different types of physical exercise during adjuvant chemotherapy and radiotherapy in breast cancer: systematic review and meta-analysis. *Support Care Cancer*. 2022 Jun;30(6):4651-4662. doi: 10.1007/s00520-022-06809-w. Epub 2022 Jan 22. PMID: 35064331.
 8. Reverte-Pagola G, Sánchez-Trigo H, Saxton J, Sañudo B. Supervised and Non-Supervised Exercise Programs for the Management of Cancer-Related Fatigue in

Women with Breast Cancer: A Systematic Review and Meta-Analysis. *Cancers* (Basel). 2022 Jul 14;14(14):3428. doi: 10.3390/cancers14143428. PMID: 35884489; PMCID: PMC9319207.

9. Contreras Molina M, Priego Jiménez S, Álvarez Bueno C, Rodríguez Martín B, Zuheros Lara B, Ruiz Grao MC. Effectiveness of physical exercise on quality of life in women with breast cancer undergoing chemotherapy: a network meta-analysis. *Ann Phys Rehabil Med*. 2026 Apr;69(3):102064. doi: 10.1016/j.rehab.2025.102064. Epub 2026 Jan 8. PMID: 41512691.
10. Courneya KS, Segal RJ, Mackey JR, Gelmon K, Reid RD, Friedenreich CM, Ladha AB, Proulx C, Vallance JK, Lane K, Yasui Y, McKenzie DC. Effects of aerobic and resistance exercise in breast cancer patients receiving adjuvant chemotherapy: a multicenter randomized controlled trial. *J Clin Oncol*. 2007 Oct 1;25(28):4396-404. doi: 10.1200/JCO.2006.08.2024. Epub 2007 Sep 4. PMID: 17785708.
11. van Waart H, Stuiver MM, van Harten WH, Geleijn E, Kieffer JM, Buffart LM, de Maaker-Berkhof M, Boven E, Schrama J, Geenen MM, Meerum Terwogt JM, van Bochove A, Lustig V, van den Heiligenberg SM, Smorenburg CH, Hellendoorn-van Vreeswijk JA, Sonke GS, Aaronson NK. Effect of Low-Intensity Physical Activity and Moderate- to High-Intensity Physical Exercise During Adjuvant Chemotherapy on Physical Fitness, Fatigue, and Chemotherapy Completion Rates: Results of the PACES Randomized Clinical Trial. *J Clin Oncol*. 2015 Jun 10;33(17):1918-27. doi: 10.1200/JCO.2014.59.1081. Epub 2015 Apr 27. PMID: 25918291.
12. Courneya KS, McKenzie DC, Mackey JR, Gelmon K, Friedenreich CM, Yasui Y, Reid RD, Cook D, Jespersen D, Proulx C, Dolan LB, Forbes CC, Wooding E, Trinh L, Segal RJ. Effects of exercise dose and type during breast cancer chemotherapy: multicenter randomized trial. *J Natl Cancer Inst*. 2013 Dec 4;105(23):1821-32. doi: 10.1093/jnci/djt297. Epub 2013 Oct 22. PMID: 24151326.
13. Schmidt ME, Wiskemann J, Armbrust P, Schneeweiss A, Ulrich CM, Steindorf K. Effects of resistance exercise on fatigue and quality of life in breast cancer patients undergoing adjuvant chemotherapy: A randomized controlled trial. *Int J Cancer*. 2015 Jul 15;137(2):471-80. doi: 10.1002/ijc.29383. Epub 2014 Dec 16. PMID: 25484317.
14. Mijwel S, Backman M, Bolam KA, Jervaeus A, Sundberg CJ, Margolin S, Browall M, Rundqvist H, Wengström Y. Adding high-intensity interval training to conventional training modalities: optimizing health-related outcomes during chemotherapy for breast cancer: the OptiTrain randomized controlled trial. *Breast Cancer Res Treat*.

- 2018 Feb;168(1):79-93. doi: 10.1007/s10549-017-4571-3. Epub 2017 Nov 14. PMID: 29139007; PMCID: PMC5847033.
15. Mijwel S, Backman M, Bolam KA, Olofsson E, Norrbom J, Bergh J, Sundberg CJ, Wengström Y, Rundqvist H. Highly favorable physiological responses to concurrent resistance and high-intensity interval training during chemotherapy: the OptiTrain breast cancer trial. *Breast Cancer Res Treat.* 2018 May;169(1):93-103. doi: 10.1007/s10549-018-4663-8. Epub 2018 Jan 18. PMID: 29349712; PMCID: PMC5882634.
 16. Mijwel S, Cardinale DA, Norrbom J, Chapman M, Ivarsson N, Wengström Y, Sundberg CJ, Rundqvist H. Exercise training during chemotherapy preserves skeletal muscle fiber area, capillarization, and mitochondrial content in patients with breast cancer. *FASEB J.* 2018 Oct;32(10):5495-5505. doi: 10.1096/fj.201700968R. Epub 2018 May 11. PMID: 29750574.
 17. Mijwel S, Jervaeus A, Bolam KA, Norrbom J, Bergh J, Rundqvist H, Wengström Y. High-intensity exercise during chemotherapy induces beneficial effects 12 months into breast cancer survivorship. *J Cancer Surviv.* 2019 Apr;13(2):244-256. doi: 10.1007/s11764-019-00747-z. Epub 2019 Mar 25. PMID: 30912010; PMCID: PMC6482129.
 18. Steindorf K, Schmidt ME, Klassen O, Ulrich CM, Oelmann J, Habermann N, Beckhove P, Owen R, Debus J, Wiskemann J, Potthoff K. Randomized, controlled trial of resistance training in breast cancer patients receiving adjuvant radiotherapy: results on cancer-related fatigue and quality of life. *Ann Oncol.* 2014 Nov;25(11):2237-2243. doi: 10.1093/annonc/mdu374. Epub 2014 Aug 5. PMID: 25096607.
 19. Schmidt ME, Meynköhn A, Habermann N, Wiskemann J, Oelmann J, Hof H, Wessels S, Klassen O, Debus J, Potthoff K, Steindorf K, Ulrich CM. Resistance Exercise and Inflammation in Breast Cancer Patients Undergoing Adjuvant Radiation Therapy: Mediation Analysis From a Randomized, Controlled Intervention Trial. *Int J Radiat Oncol Biol Phys.* 2016 Feb 1;94(2):329-37. doi: 10.1016/j.ijrobp.2015.10.058. Epub 2015 Nov 2. PMID: 26853341.
 20. Mavropalias G, Cormie P, Peddle-McIntyre CJ, Galvão DA, Taaffe DR, Schofield C, Ray S, Zissiadis Y, Newton RU. The effects of home-based exercise therapy for breast cancer-related fatigue induced by radical radiotherapy. *Breast Cancer.* 2023

Jan;30(1):139-150. doi: 10.1007/s12282-022-01408-3. Epub 2022 Oct 14. PMID: 36239907; PMCID: PMC9813229.

21. Haussmann A, Schmidt ME, Goldschmidt S, Hiensch AE, Wiskemann J, Steindorf K. Effects of aerobic or resistance exercise on sleep and cancer-related fatigue in patients with breast cancer during or after neoadjuvant chemotherapy: a 3-arm randomized controlled trial. *BMC Med.* 2026 Jan 28;24(1):114. doi: 10.1186/s12916-026-04669-3. PMID: 41593692; PMCID: PMC12924517.
22. Schmidt ME, Goldschmidt S, Kreutz C, Müller J, Schneeweiss A, May AM, Rosenberger F, Wiskemann J, Steindorf K. Effects of aerobic or resistance exercise during neoadjuvant chemotherapy on tumor response and therapy completion in women with breast cancer: The randomized controlled BENEFIT trial. *J Sport Health Sci.* 2025 Dec;14:101064. doi: 10.1016/j.jshs.2025.101064. Epub 2025 May 28. PMID: 40447136; PMCID: PMC12395146.
23. Kjeldsted E, Ammitzbøll G, Lænkholm AV, Rasic D, Ceballos SG, Jørgensen LB, Skou ST, Bojesen RD, Lodin A, Tolver A, Rosthøj S, Jack S, Gehl J, Dalton SO. Effects of Supervised Exercise during Neoadjuvant Chemotherapy on Tumor Response in Patients with Breast Cancer (Neo-train): A Randomized Controlled Trial. *Clin Cancer Res.* 2025 Oct 15;31(20):4265-4277. doi: 10.1158/1078-0432.CCR-25-0416. PMID: 40788186; PMCID: PMC12521908.
24. Mutrie N, Campbell AM, Whyte F, McConnachie A, Emslie C, Lee L, Kearney N, Walker A, Ritchie D. Benefits of supervised group exercise programme for women being treated for early stage breast cancer: pragmatic randomised controlled trial. *BMJ.* 2007 Mar 10;334(7592):517. doi: 10.1136/bmj.39094.648553.AE. Epub 2007 Feb 16. PMID: 17307761; PMCID: PMC1819494.