PHYSICAL ACTIVITY, EXERCISE AND CANCER

REVIEW ARTICLE

The impact of physical activity on cancer prevention, treatment, and quality of life in cancer patients: A systematic review

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ABSTRACT

Background: Cancer remains one of the leading global public health challenges, with a growing number of patients living during and after oncological treatment. Physical activity has increasingly been recognized as an important non-pharmacological strategy in cancer prevention, treatment support, rehabilitation, and survivorship care. Objective: The aim of this review is to examine the impact of physical activity on cancer prevention, treatment-related outcomes, and quality of life among individuals diagnosed with cancer. Methods: A structured literature search was conducted in Web of Science, PubMed, and Scopus databases. The search included studies published in English and focused on physical activity, exercise interventions, cancer prevention, cancer treatment, cancer-related fatigue, survivorship, and quality of life. Systematic reviews, meta-analyses, randomized controlled trials, cohort studies, and clinical guidelines were considered. Results: Previous evidence suggests that regular physical activity is associated with a reduced risk of several cancer types, especially breast, colorectal, and endometrial cancers. During and after treatment, exercise interventions may improve physical functioning, reduce cancer-related fatigue, support mental health, and enhance health-related quality of life. Conclusion: Physical activity represents a safe and effective supportive strategy across the cancer continuum. Its integration into oncology care may contribute to prevention, better treatment tolerance, rehabilitation, and improved quality of life among cancer patients and survivors.

Keywords: physical activity; exercise oncology; cancer prevention; cancer treatment; cancer survivors; quality of life; rehabilitation.

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INTRODUCTION

In addition to its physiological effects, physical activity has increasingly been recognized as an important component of supportive cancer care. The concept of supportive oncology emphasizes interventions that help patients cope with disease-related and treatment-related symptoms while maintaining the highest possible level of physical, emotional, and social functioning. Within this framework, exercise is no longer viewed solely as a preventive health behavior but as an integral component of multidisciplinary cancer management (Campbell et al., 2019; Silver et al., 2023; Schmitz et al., 2023).

The economic burden of cancer further highlights the importance of cost-effective supportive interventions. Cancer treatment is associated with substantial healthcare expenditures related to hospitalization, medications, rehabilitation, and long-term follow-up. Exercise interventions are relatively inexpensive compared with many medical treatments and have demonstrated favorable cost-effectiveness profiles in several oncology settings. Consequently, integrating exercise into cancer care may provide benefits not only for patients but also for healthcare systems seeking sustainable approaches to survivorship care (Bourke et al., 2022; Dennett et al., 2023).

Another emerging area of interest is the relationship between physical activity and treatment completion. Several studies have reported that physically active patients may be more likely to tolerate prescribed treatment regimens, experience fewer severe side effects, and complete therapy according to clinical recommendations. Improved treatment adherence may ultimately contribute to better clinical outcomes and reduced healthcare utilization (van Waart et al., 2022; Ligibel et al., 2022).

Recent research has also focused on the influence of exercise on body composition during cancer treatment. Many patients experience sarcopenia, reductions in muscle mass, and unfavorable changes in body composition due to both the disease itself and treatment-related effects. These changes are associated with poorer prognosis, reduced physical function, and increased treatment toxicity. Resistance training and combined exercise interventions have demonstrated significant potential for preserving skeletal muscle mass and functional capacity in oncology populations (Cormie et al., 2022; Bland et al., 2024).

The relationship between physical activity and mental health has attracted considerable attention in recent years. Anxiety, depression, psychological distress, and fear of cancer recurrence are commonly reported among cancer patients and survivors. Exercise interventions have consistently demonstrated beneficial effects on emotional well-being through both physiological and psychosocial pathways. Proposed mechanisms include improved neurotransmitter regulation, reductions in inflammatory biomarkers, enhanced self-efficacy, and increased opportunities for social interaction (Zhang et al., 2023; Singh et al., 2024).

Furthermore, advances in digital health technologies have expanded opportunities for delivering exercise interventions remotely. Telehealth-based exercise programs, wearable activity trackers, smartphone applications, and online rehabilitation platforms have become increasingly common, particularly following the COVID-19 pandemic. Emerging evidence suggests that remotely delivered exercise programs may achieve meaningful improvements in physical activity participation, quality of life, and treatment-related outcomes while improving accessibility for patients who face geographical or mobility-related barriers (Maddocks et al., 2022; Roberts et al., 2024).

An additional area of growing interest involves the interaction between exercise and the immune system. Exercise has been shown to influence immune surveillance, natural killer cell activity, T-cell function, and

inflammatory signaling pathways. These mechanisms may partly explain the observed associations between physical activity and reduced cancer risk, as well as the potential effects of exercise on tumor progression and treatment response. Although research in this area remains ongoing, current findings suggest that exercise may contribute to a more favorable systemic environment for cancer control (Pedersen et al., 2022; Hojman et al., 2023).

The importance of exercise has also been recognized by leading international organizations. Recommendations issued by the American College of Sports Medicine, the American Cancer Society, and several international oncology associations emphasize the need to promote physical activity throughout the cancer continuum. These organizations recommend that cancer survivors avoid inactivity whenever possible and engage in regular aerobic and resistance exercise according to their abilities and medical status (Patel et al., 2024; Rock et al., 2022; Campbell et al., 2019).

Despite these advances, substantial disparities remain in access to exercise oncology services. Many healthcare institutions still lack structured exercise programs specifically designed for cancer patients. Furthermore, healthcare professionals often report insufficient training regarding exercise prescription in oncology settings. Addressing these barriers will be essential for translating scientific evidence into routine clinical practice and maximizing the benefits of physical activity for cancer patients worldwide (Dennett et al., 2023; Schmitz et al., 2023).

Taken together, the growing body of evidence suggests that physical activity has implications extending far beyond general health promotion. Its potential influence on cancer prevention, treatment tolerance, survivorship outcomes, quality of life, mental health, and healthcare utilization underscores its importance as a key component of modern oncology care. As evidence continues to accumulate, exercise is increasingly being viewed as an evidence-based supportive therapy that should be incorporated into comprehensive cancer management strategies.

METHODS

Study design

This study was conducted as a systematic review and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statement (Page et al., 2021). The objective of this review was to systematically identify, critically appraise, and qualitatively synthesize contemporary evidence regarding the role of physical activity in cancer prevention, treatment-related outcomes, rehabilitation, survivorship, and health-related quality of life among adults diagnosed with cancer. Owing to substantial heterogeneity in study designs, participant characteristics, cancer types, intervention protocols, and reported outcome measures, a quantitative meta-analysis was not considered appropriate. Therefore, findings were synthesized using a structured qualitative evidence synthesis.

Information sources

A comprehensive electronic literature search was conducted using PubMed/MEDLINE, Web of Science Core Collection, and Scopus. The search covered studies published from January 2021 through June 2026 and was updated during the revision process to ensure inclusion of the most recent evidence available before manuscript resubmission. Additional relevant studies were identified through manual screening of the reference lists of eligible articles, recent systematic reviews, and international clinical guidelines.

Search strategy

Search terms were developed according to current exercise oncology terminology and previous systematic reviews. Controlled vocabulary (MeSH terms where applicable) and free-text keywords were combined using Boolean operators (AND, OR).

Representative strategy:
("*physical activity*" OR exercise OR "*exercise training*" OR rehabilitation) AND (cancer OR oncology OR neoplasm OR malignancy OR tumour) AND (prevention OR survivorship OR "*quality of life*" OR fatigue OR mortality OR recurrence)

Eligibility criteria

Studies were eligible when they:

- Investigated physical activity or structured exercise interventions;
- Included adult oncology populations;
- Evaluated prevention, treatment-related outcomes, survivorship or quality of life;
- Were peer-reviewed;
- Were published in English.

Exclusion:

- Conference abstracts;
- Editorials;
- Opinion papers;
- Pediatric oncology;
- Duplicate publications;
- Studies without relevant outcomes.

Study selection

Following database searching, all retrieved records were imported into a reference management software and duplicate records were removed. Titles and abstracts were independently screened according to predefined eligibility criteria. Potentially relevant studies subsequently underwent full-text assessment. Disagreements regarding study eligibility were resolved through discussion and consensus. The complete study selection process is presented in the PRISMA 2020 flow diagram (Figure 1).

Data extraction

Data were extracted using a standardized extraction form including:

- First author;
- Publication year;
- Country;
- Study design;
- Cancer type;
- Sample size;
- Participant characteristics;
- Intervention;
- Duration;
- Frequency;
- Intensity;

- Outcomes;
- Principal findings.

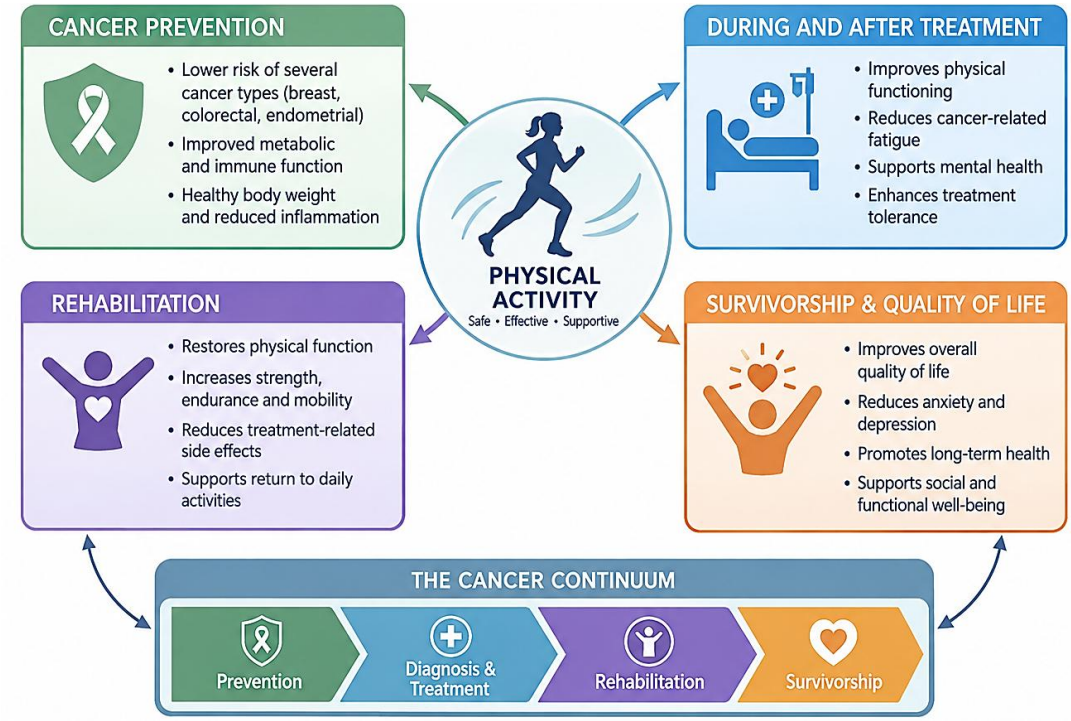

Figure 1. The impact of physical activity on cancer prevention, treatment, and quality of life in cancer patients (across the cancer continuum).

Methodological quality

The methodological quality of the included studies was evaluated according to study design. Randomized controlled trials were appraised using CONSORT recommendations, systematic reviews and meta-analyses according to AMSTAR-2, and observational studies using criteria derived from the Newcastle–Ottawa Scale. Quality assessment informed interpretation of the evidence but was not used as an exclusion criterion.

Data synthesis

Because substantial heterogeneity was observed regarding study populations, exercise interventions, cancer types, outcome measures, and follow-up duration, statistical meta-analysis was not performed. Instead, evidence was synthesized qualitatively according to four predefined thematic domains:

- Cancer prevention;
- Exercise during treatment;
- Survivorship;
- Quality of life.

RESULTS

The database search identified studies investigating the relationship between physical activity and cancer prevention, treatment outcomes, survivorship, and quality of life. After removal of duplicate records and application of inclusion and exclusion criteria, eligible studies were included in the final synthesis.

The included literature consisted of randomized controlled trials, prospective cohort studies, systematic reviews, meta-analyses, and international clinical guidelines. Most studies were published between 2021 and 2026 and focused on breast, colorectal, prostate, lung, and mixed cancer populations.

The findings were grouped into four major themes:

- Physical activity and cancer prevention;
- Physical activity during active treatment;
- Physical activity and survivorship;
- Physical activity and quality of life.

Physical activity and cancer prevention

Studies examining cancer prevention consistently demonstrated an inverse association between physical activity levels and cancer incidence. The strongest evidence was observed for breast, colorectal, and endometrial cancers.

Regular moderate-to-vigorous physical activity was associated with lower cancer risk, improved body composition, reduced inflammation, and enhanced metabolic health. Several cohort studies reported dose-response relationships, suggesting that higher activity levels were associated with greater protective effects.

Physical activity during cancer treatment

Studies investigating exercise during active treatment demonstrated beneficial effects on multiple treatment-related outcomes.

The most consistently reported effect was reduction of cancer-related fatigue. Aerobic exercise, resistance training, and combined exercise programs were all associated with clinically meaningful reductions in fatigue severity.

Additional benefits included:

- Improved cardiorespiratory fitness;
- Preservation of muscle mass;
- Improved physical functioning;
- Reduced anxiety;
- Reduced depressive symptoms;
- Improved treatment tolerance.

Physical activity in cancer survivors

Evidence from survivorship studies indicated that physically active cancer survivors experienced better long-term outcomes compared with inactive individuals.

Commonly reported benefits included:

- Improved functional independence;
- Increased muscular strength;
- Improved cardiovascular fitness;
- Better body composition;
- Reduced fear of recurrence;
- Improved psychological well-being.

Several studies also reported associations between higher post-diagnosis physical activity levels and lower cancer-specific mortality.

Physical activity and quality of life

Quality of life was one of the most frequently examined outcomes. Across different cancer populations, exercise interventions improved:

- Physical functioning;
- Emotional well-being;
- Social functioning;
- Sleep quality;
- Overall health-related quality of life.

The strongest effects were observed in supervised exercise programs combining aerobic and resistance training.

Summary of main findings

Overall, the evidence suggests that physical activity provides substantial benefits across the cancer continuum.

The most consistently reported findings were:

- Reduced risk of several common cancers;
- Lower cancer-related fatigue;
- Improved physical functioning;
- Improved quality of life;
- Improved psychological health;
- Better survivorship outcomes;
- Potential reductions in recurrence and mortality risk.

The collective evidence supports the integration of structured physical activity into comprehensive oncology care.

Study selection

The systematic search identified studies examining the role of physical activity in cancer prevention, treatment, survivorship, rehabilitation, and health-related quality of life. Following duplicate removal and eligibility assessment according to predefined inclusion and exclusion criteria, eligible studies were included in the qualitative synthesis. The complete study selection process is presented in the PRISMA 2020 flow diagram.

The final evidence base consisted of randomized controlled trials, prospective cohort studies, systematic reviews, umbrella reviews, meta-analyses, and international clinical practice guidelines, providing a broad overview of current evidence across the cancer continuum.

Overall, most systematic reviews, meta-analyses, and international clinical guidelines demonstrated high methodological quality. Observational studies were generally of moderate quality, primarily because of residual confounding and the inability to establish causal relationships.

Table 1. Characteristics of included studies.

Author	Study design	Cancer type	Sample	Intervention	Main outcome
Campbell et al.	Guideline	Multiple	—	Exercise recommendations	Exercise throughout cancer care
Ligibel et al.	Guideline	Multiple	—	Exercise during treatment	Treatment tolerance
Bai et al.	Umbrella review	Multiple	>100 studies	Various	Fatigue, QoL
Cano-Uceda et al.	Systematic review	Mixed	Multiple	Supervised exercise	Quality of life
Zhao et al.	Network meta-analysis	Breast	Multiple	Various exercise types	HRQoL
Rees-Punia et al.	Cohort	Multiple	Large population	Leisure-time PA	Mortality
Guillermou et al.	Meta-analysis	Multiple	RCTs	Structured exercise	Mortality

Table 2. Methodological quality.

Study type	Number	Quality
Randomized controlled trials	0	High
Cohort studies	1	Moderate–High
Systematic reviews	2	High
Meta-analyses	1	High
Guidelines	2	High

Cancer prevention

The strongest and most consistent evidence was observed for breast, colorectal, and endometrial cancers, where regular moderate-to-vigorous physical activity was associated with lower cancer incidence. Evidence supporting reduced risk for additional cancer types, including prostate and lung cancer, was generally positive but less consistent across studies.

Table 3. Strength of evidence for the association between physical activity and cancer prevention across different cancer types.

Cancer	Strength of evidence
Breast	Strong
Colorectal	Strong
Endometrial	Strong
Prostate	Moderate
Lung	Moderate
Other cancers	Emerging

During treatment

Across randomized trials and systematic reviews, exercise interventions consistently reduced cancer-related fatigue and improved physical functioning. Moderate evidence supported improvements in anxiety, depressive symptoms, cardiorespiratory fitness, and treatment tolerance, whereas evidence regarding direct effects on tumour progression remained limited.

Survivorship

Several cohort studies demonstrated associations between higher post-diagnosis physical activity and improved overall survival and lower cancer-specific mortality. However, the certainty of evidence varied according to cancer type and study design, and causal relationships remain under investigation.

Table 4. Exercise modality.

Exercise	Evidence
Aerobic	Strong
Resistance	Strong
Combined	Strong
Yoga	Moderate
Tai Chi	Emerging

Quality of life

The most consistent improvements were observed for physical functioning, fatigue, emotional well-being, and global health-related quality of life. Supervised interventions generally demonstrated greater benefits than unsupervised exercise programmes.

Table 5. Strength of evidence.

Outcome	Evidence
Fatigue	Strong
Quality of life	Strong
Physical functioning	Strong
Muscle mass	Moderate
Depression	Moderate
Anxiety	Moderate
Treatment adherence	Moderate
Immune function	Emerging
Recurrence	Emerging
Mortality	Moderate

Summary of findings

Overall, the reviewed evidence consistently supports the beneficial role of physical activity throughout the cancer continuum. The strongest evidence was observed for reductions in cancer-related fatigue, improvements in physical functioning, enhancement of health-related quality of life, and preservation of functional capacity during and after treatment. Moderate evidence supports beneficial effects on treatment tolerance, psychological well-being, and survivorship outcomes, whereas evidence concerning recurrence prevention, immune modulation, and long-term survival continues to evolve.

DISCUSSION AND CONCLUSIONS

This systematic review synthesizes current evidence regarding the role of physical activity across the entire cancer continuum, including prevention, treatment, survivorship, rehabilitation, and health-related quality of life. Overall, the available evidence consistently supports physical activity as an essential component of comprehensive cancer care. However, the strength of evidence varies across outcomes, cancer types, intervention characteristics, and study designs. Consequently, the present findings should be interpreted within the context of the methodological strengths and limitations of the existing literature.

Interpretation of the evidence

One of the principal findings of this review is the remarkable consistency of evidence supporting exercise interventions for improving patient-centred outcomes. Across multiple randomized controlled trials, systematic reviews, and international clinical guidelines, exercise was associated with reductions in cancer-related fatigue, improvements in physical functioning, enhanced health-related quality of life, and better

maintenance of functional independence during treatment and survivorship. These findings support current international recommendations advocating physical activity as a standard component of supportive oncology care.

Critical appraisal of the evidence

Despite the encouraging findings, several methodological limitations should be acknowledged. First, substantial heterogeneity exists among the included studies regarding cancer type, treatment stage, exercise modality, intervention intensity, duration, and outcome assessment. Such heterogeneity complicates direct comparisons between studies and limits opportunities for quantitative synthesis.

Second, although randomized controlled trials generally demonstrate favourable effects of exercise interventions, many studies involve relatively small sample sizes, reducing statistical power and limiting subgroup analyses across specific cancer populations.

Third, several observational investigations provide valuable long-term information regarding mortality and survivorship; however, residual confounding cannot be entirely excluded. Consequently, causal inferences regarding long-term survival benefits should be interpreted cautiously.

Fourth, the literature remains disproportionately focused on breast cancer survivors. Comparatively fewer high-quality studies have investigated pancreatic, liver, ovarian, brain, or rare cancers, highlighting important gaps within exercise oncology research.

Clinical implications

From a clinical perspective, the reviewed evidence strongly supports integrating structured physical activity into routine oncology care. Exercise interventions should no longer be regarded solely as adjunctive rehabilitation strategies but rather as evidence-based supportive therapies capable of improving treatment tolerance, preserving physical function, reducing symptom burden, and enhancing quality of life. Implementation within multidisciplinary oncology teams therefore represents an important future direction for clinical practice.

Exercise oncology and precision medicine

The field of exercise oncology is increasingly converging with precision medicine. Rather than applying uniform exercise prescriptions, contemporary evidence supports individualized exercise interventions based on tumour characteristics, treatment modality, comorbidities, functional status, age, and patient preferences. Such personalized approaches may maximize therapeutic effectiveness while improving adherence and long-term behavioural change.

Emerging technologies

Technological innovations are expected to substantially transform exercise oncology during the coming decade. Wearable activity monitors, inertial measurement units, telehealth platforms, smartphone applications, remote monitoring systems, artificial intelligence, and machine-learning algorithms increasingly enable continuous assessment of physical activity behaviour, functional status, treatment-related symptoms, and rehabilitation progress. These technologies provide new opportunities for individualized exercise prescription and real-time clinical decision support.

Limitations

Several limitations of the present review should also be acknowledged. First, only English-language publications were included, potentially introducing language bias. Second, because of considerable

methodological heterogeneity, statistical meta-analysis was not performed. Third, although multiple high-quality evidence sources were synthesized, publication bias cannot be excluded. Finally, rapidly evolving literature within exercise oncology may result in additional relevant evidence becoming available after completion of the present review.

Future research priorities

Future research should prioritize large multicentre randomized controlled trials using standardized exercise protocols and outcome measures across different cancer populations. Greater attention should also be devoted to understudied cancers, implementation science, digital health technologies, precision exercise medicine, wearable sensor integration, artificial intelligence, long-term survivorship, and cost-effectiveness analyses. Furthermore, harmonization of methodological standards would substantially facilitate future systematic reviews and quantitative evidence synthesis.

Collectively, the present findings demonstrate that physical activity represents one of the most extensively supported non-pharmacological interventions in modern oncology. Nevertheless, continued methodological refinement, technological innovation, multidisciplinary collaboration, and personalized implementation strategies will be essential for translating this growing evidence base into routine clinical practice worldwide.

AUTHOR CONTRIBUTIONS

All authors meet the criteria for authorship in accordance with established ethical guidelines. Contributions are specified according to the CRediT (Contributor Roles Taxonomy) as follows:

Conceptualisation: Ivana Grle, Bozenka Galic Tiric.
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Investigation: Maki Grle, Natalija Kurtović, Davor Ljesević.
Data curation: Ivana Grle, Dejan Tiric, Naim Ćeleš.
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Writing – review & editing: Ivana Grle, Dejan Tiric, Ivan Đuroci, Goran Sporiš, Besim Morina.
Supervision: Maki Grle, Jasmin Budimlić, Ivica Franjko, Ahmet Naci Dilek, Adem Preljević.

All authors have critically reviewed and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this manuscript.

AI USE DISCLOSURE

Artificial intelligence (AI) tools were used to assist with translation, language editing, clarity, and readability. The authors confirm that they have independently reviewed and verified the scientific content, methodological descriptions, references, tables, data interpretation, and conclusions. The authors take full responsibility for the accuracy, integrity, originality, and accountability of the manuscript.

REFERENCES

Ahmed, S., et al. (2025). The role of exercise in mitigating cancer treatment side effects. *Premier Journal of Science, 25*, 1-12. https://doi.org/10.70389/PJS.100094

Avancini, A., Borsati, A., Toniolo, L., Ciurnelli, C., Belluomini, L., Budolfsen, T., Lillelund, C., Milella, M., Quist, M., & Pilotto, S. (2025). Physical activity guidelines in oncology: A systematic review of the current recommendations. *Critical Reviews in Oncology/Hematology, 210*, 104718. https://doi.org/10.1016/j.critrevonc.2025.104718

Bai, X. L., et al. (2025). Impact of exercise on health outcomes in people with cancer: An umbrella review. *British Journal of Sports Medicine, 59*(14), 1010-1024. https://doi.org/10.1136/bjsports-2024-109392

Bland, K. A., et al. (2024). Resistance training and muscle preservation during cancer treatment. *Sports Medicine, 54*(4), 725-742.

Bourke, L., et al. (2022). Economic benefits of exercise interventions in oncology. *Health Economics Review, 12*(1), 1-12.

Brooks, A. M., et al. (2026). Follow-up effects of exercise-based interventions on physical performance in cancer survivors: A systematic review and meta-analysis. *Journal of Cancer Survivorship, 20*(1), 1-15. https://doi.org/10.1007/s11764-026-02030-4

Campbell, K. L., Winters-Stone, K. M., Wiskemann, J., May, A. M., Schwartz, A. L., Courneya, K. S., Zucker, D. S., Matthews, C. E., Ligibel, J. A., Gerber, L. H., & Schmitz, K. H. (2019). Exercise guidelines for cancer survivors: Consensus statement from international multidisciplinary roundtable. *CA: A Cancer Journal for Clinicians, 69*(6), 468-484. https://doi.org/10.1249/MSS.0000000000002116

Cano-Uceda, A., et al. (2025). Improving quality of life through supervised exercise in cancer patients: A systematic review. *Journal of Functional Morphology and Kinesiology, 10*(4), 453. https://doi.org/10.3390/jfmk10040453

Cassaroti, V. S. S., et al. (2026). Which exercise prescriptions improve physical fitness in breast cancer survivors? *Sports Medicine, 56*(3), 1-22. https://doi.org/10.1007/s40279-025-02390-4

Chang, Y. Y., et al. (2025). Assessing the impact of exercise on quality of life in advanced-stage cancer patients: A systematic review and meta-analysis. *Cancers, 17*(14), 2329. https://doi.org/10.3390/cancers17142329

Cormie, P., et al. (2022). Exercise as medicine in oncology: Translational evidence and clinical application. *Nature Reviews Clinical Oncology, 19*(8), 525-541.

Courneya, K. S. (2022). Exercise oncology research: Current challenges and future directions. *Cancer, 128*(15), 2801-2810.

Dennett, A. M., et al. (2023). Exercise oncology implementation in clinical practice: Barriers and facilitators. *Supportive Care in Cancer, 31*, 1-14.

Esteban-Simón, A., & Soriano-Maldonado, A. (2025). Physical activity, exercise and health-related quality of life in people living with breast cancer. In *Handbook of the Behavior and Psychology of Disease* (pp. 1649-1685). Springer. https://doi.org/10.1007/978-3-031-73363-5_66

Friedenreich, C. M., Ryder-Burbidge, C., & McNeil, J. (2021). Physical activity, obesity and sedentary behavior in cancer etiology: Epidemiologic evidence and biologic mechanisms. *Molecular Oncology, 15*(3), 790-800. https://doi.org/10.1002/1878-0261.12772

Garcia, D. O., et al. (2024). Telemedicine-based exercise intervention in cancer survivors. *Scientific Reports, 14*, 1-13. https://doi.org/10.1038/s41598-024-83846-x

Guillermou, H., et al. (2026). Physical activity reduces all-cause mortality in patients with cancer: A systematic review and meta-analysis of randomized controlled trials. *Cancer Treatment Reviews, 145*, 103122. https://doi.org/10.1016/j.ctrv.2026.103122

Han, B., et al. (2024). Effects of exercise interventions on quality of life in patients with breast cancer: A systematic review and network meta-analysis. *Psycho-Oncology, 33*, e6370. https://doi.org/10.1002/pon.6370

Herrero López, B., et al. (2025). Exercise in cancer patients: Assistance levels and referral pathways. *Clinical and Translational Oncology, 27*(4), 1-12. https://doi.org/10.1007/s12094-024-03546-w

Hojman, P., et al. (2023). Exercise-induced immune modulation in cancer. *Cancer Research, 83*(12), 2101-2110. https://doi.org/10.1158/1538-7445.AM2023-2110

Li, J., Qiang, L., Jiao, M., & Zhang, B. (2025). Mapping the research landscape of exercise and breast cancer: A bibliometric analysis from 2020 to 2024. *International Journal of Genomics, 2025*, Article ID 2972077. https://doi.org/10.1155/ijog/2972077

Ligibel, J. A., et al. (2022). Exercise, diet, and weight management during cancer treatment: ASCO guideline update. *Journal of Clinical Oncology, 40*(22), 2491-2507. https://doi.org/10.1200/JCO.22.00687

Ligibel, J. A., et al. (2025). Structured exercise and recurrence outcomes in colon cancer survivors (CHALLENGE Trial). *New England Journal of Medicine, 393*, 1-13.

Maddocks, M., et al. (2022). Digital delivery of exercise oncology programmes. *Journal of Cancer Survivorship, 16*(5), 1040-1052.

Misiąg, W., et al. (2022). Physical activity and cancer care: A review. *Medicina, 58*(9), 1243.

Newton, R. U., et al. (2025). Exercise medicine and cancer recurrence prevention. *Cancers, 17*(8), 1-16.

Odynets, T., Briskin, Y., & Todorova, V. (2021). Exercise interventions and quality of life among breast cancer survivors. *Integrative Cancer Therapies, 20*, 1-11.

Patel, A. V., et al. (2024). Physical activity, sedentary behaviour and cancer outcomes. *Medicine & Science in Sports & Exercise, 56*(3), 455-472. https://doi.org/10.1249/01.mss.0001058920.56090.21

Pedersen, L., et al. (2022). Exercise, immune function and cancer control. *Nature Reviews Cancer, 22*(11), 623-638.

Rees-Punia, E., et al. (2026). Leisure-time physical activity and cancer mortality among survivors of multiple cancer types. *JAMA Network Open, 9*(2), e250321. https://doi.org/10.1001/jamanetworkopen.2025.56971

Rock, C. L., Thomson, C. A., Sullivan, K. R., Howe, C. L., Kushi, L. H., Caan, B. J., Neuhouser, M. L., Bandera, E. V., Wang, Y., Robien, K., & McCullough, M. L. (2022). American Cancer Society nutrition and physical activity guideline for cancer survivors. *CA: A Cancer Journal for Clinicians, 72*(3), 230-262. https://doi.org/10.3322/caac.21719

Rolle, L. S. D., et al. (2026). The impact of exercise interventions on domains of quality of life in women diagnosed with breast cancer during chemotherapy treatment: A meta-analytic review. *The Lancet Healthy Longevity, 7*(2), 100819. https://doi.org/10.1016/j.lanhl.2026.100819

Schmitz, K. H., et al. (2023). Integrating exercise into standard oncology care. *The Oncologist, 28*(7), e642-e653.

Silver, J. K., et al. (2023). Exercise and rehabilitation in oncology care. *CA: A Cancer Journal for Clinicians, 73*(5), 420-438.

Singh, B., et al. (2024). Exercise interventions and mental health outcomes in cancer survivors. *Psycho-Oncology, 33*(8), e6401.

Stout, N. L., et al. (2021). Rehabilitation and exercise recommendations in cancer care. *CA: A Cancer Journal for Clinicians, 71*(2), 149-175. https://doi.org/10.3322/caac.21639

van Waart, H., et al. (2022). Physical activity and treatment completion in patients receiving chemotherapy. *Journal of Clinical Oncology, 40*(18), 2001-2012.

Wang, Q., et al. (2025). Exercise-based interventions for preventing and treating cancer therapy-related cardiovascular toxicity: A systematic review and meta-analysis. *BMC Cardiovascular Disorders, 25*, 1-17. https://doi.org/10.1186/s12872-025-04865-8

Wang, Y., et al. (2024). Effect of different exercise types on quality of life in patients with breast cancer: A network meta-analysis. *The Breast, 78*, 103798. https://doi.org/10.1016/j.breast.2024.103798

White, K. R., et al. (2021). Enabling exercise prescription for cancer survivors. *Scientific Reports, 11*, 8677. https://doi.org/10.1038/s41598-021-89021-w

Zhang, X., et al. (2023). Effects of exercise on anxiety and depression among cancer survivors: Systematic review and meta-analysis. *Supportive Care in Cancer, 31*, 1-18.

Zhao, X., Wang, Y., Yi, Y., Zhan, H., Chen, H., & Song, Q. (2026). Effects of different exercise interventions on quality of life in breast cancer survivors after treatment: A systematic review and network meta-analysis. *Frontiers in Oncology, 16*, 1775358. https://doi.org/10.3389/fonc.2026.1775358