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REVIEW ARTICLE

The Impacts of Exercises on Health-related Quality of Life in Cancer Patients: A Narrative Review

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ABSTRACT

Background. Cancer encompasses numerous diseases affecting various body parts, causing significant psychological, societal, and economic impacts. As a primary global health concern, its increasing incidence profoundly impacts patients' quality of life (QOL). Recent research highlights physical activity's role in enhancing QOL for cancer patients. Moderate-intensity exercise improves overall health and reduces the likelihood of developing cancer. **Objectives.** This study evaluated physical activity's effects on QOL in cancer patients, mainly focusing on cancer-related fatigue (CRF). **Methods.** An extensive electronic literature search using MeSH terms and keywords (Neoplasm OR Cancer AND Physical Activity OR Exercise) with Boolean operators "OR" and "AND" identified relevant studies. The search aimed to include a broad range of research articles assessing physical activity's impact on cancer patients' QOL. The initial search yielded 100 studies. After reviewing titles and abstracts and applying strict inclusion and exclusion criteria, 22 studies were selected for full-text screening. Ultimately, nine studies met the criteria for inclusion in this comprehensive review. **Results.** The nine selected studies consistently indicate that cancer patients engaging in various forms of physical exercise experience significant QOL improvements. These improvements include reductions in anxiety, depression, and CRF, alongside enhancements in mental health and overall well-being. **Conclusion.** Exercise programs are safe and highly beneficial for improving QOL and alleviating CRF in cancer patients before, during, and after treatment. Physical activity helps mitigate cancer treatment and adverse effects. Encouraging physical activity as a standard part of cancer care can be crucial in enhancing patient outcomes.

KEYWORDS: ***Rehabilitation, Physiotherapy, Patient Care, Exercise Training, Quality of Life, Cancer.***

INTRODUCTION

Cancer is a term that encompasses a wide variety of diseases capable of affecting virtually any part of the human body. Often referred to as neoplasms or malignant tumors, cancer is characterized by the rapid and uncontrolled proliferation of abnormal cells (1, 2). These cells extend beyond their usual boundaries, facilitating their infiltration into surrounding tissues and potentially spreading to other body regions in a process known as metastasis (3-5). In 2020, cancer stood as one of the leading causes of death worldwide, with the most prevalent forms including lung, colorectal, liver, stomach, and breast cancers (6, 7). The global burden of cancer underscores the urgent need for effective prevention and treatment strategies.

One of the promising areas of research in cancer prevention and management is the role of physical activity. Physical activity encompasses any movement of skeletal muscles that results in energy expenditure (8). This broad definition includes activities related to occupation, sports, conditioning exercises, household chores, and other routine tasks. Exercise, a specific subset of

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physical activity, is defined by its planned, structured, and repetitive nature, aimed at improving or maintaining physical fitness and overall health. Numerous studies have demonstrated that regular exercise enhances physical capacity and mitigates various illnesses and treatment-related side effects, such as diminished body strength, fatigue, reduced quality of life (QOL), and functional performance in patients with advanced-stage cancer (9).

Exercise-induced improvements in QOL are multifaceted. Physical activity can alleviate symptoms such as fatigue, pain, and insomnia, which cancer patients commonly experience. It can also enhance psychological well-being by reducing anxiety and depression, fostering a sense of control and empowerment, and improving social interactions and support (10). These psychosocial benefits are crucial, as mental health significantly influences overall health outcomes and QOL in cancer patients (11).

The benefits of regular exercise extend beyond mere physical improvements. It has been shown to slow disease progression, reduce inflammation in chronic inflammatory conditions, and bolster the immune system. Specific studies have highlighted the positive impact of exercise regimens on survival rates in breast cancer patients (12). Similarly, increased physical activity has been associated with significantly lower prostate cancer-specific and overall mortality rates (13). Beyond enhancing survival, numerous studies indicate that physical activity substantially improves QOL following a cancer diagnosis. This improvement encompasses various dimensions of well-being, including physical, functional, psychological, and emotional health (14). The World Health Organization (WHO) strongly advocates for regular physical activity, emphasizing its role in enhancing QOL and reducing the risk of several chronic diseases, including cardiovascular diseases, diabetes, and cancer (15-17).

Despite these well-documented benefits, the precise molecular mechanisms underlying the multifaceted effects of exercise on cancer patients remain largely unexplored. Most current insights are derived from rodent models and cell culture studies, with human evidence still nascent (18). Determining the clinically relevant thresholds for exercise-induced immuno-inflammatory responses in cancer patients requires further investigation. While the anti-inflammatory benefits of physical activity in healthy individuals are well-established, their impact on cancer patients, particularly those suffering from cancer-related fatigue (CRF), remains uncertain. Additionally, it is unclear what types of exercise yield the best outcomes for QOL and immune function in cancer patients (19).

This study aims to fill these gaps in knowledge by elucidating the effects of physical activity on QOL in cancer patients. It also seeks to evaluate the prevalence and severity of CRF in these patients and explore its association with physical activity. By doing so, this research hopes to contribute to the growing body of evidence supporting exercise as a beneficial adjunct therapy in cancer care.

MATERIALS AND METHODS

An electronic literature search combined MeSH terminology and keywords with the Boolean operators "OR" and "AND" to find relevant published studies on PubMed, Scopus, and ScienceDirect databases. The keywords (Neoplasm OR Cancer AND Physical Activity OR Exercise) with Boolean were used to identify the relevant studies.

After a literature search, all studies that investigated the effects of physical activity on QOL and CRF on cancer patients were included. A literature management software (EndNote X9, Clarivate Analytics, Philadelphia, PA, USA) was used to manage the literature search records.

Therefore, 100 studies were retrieved from PubMed, Scopus, and ScienceDirect using all MeSH keywords. After reviewing titles and abstracts and applying strict inclusion and exclusion criteria, 22 studies were selected for full-text screening. Ultimately 9 articles and data extraction were performed on the 9 studies that fully met the eligibility criteria.

Inclusion criteria:

1. Studies that have physical activity/exercise intervention on cancer patients
2. Publication in English with full text available
3. Clinical studies

Exclusion criteria included all review articles, case reports, commentary, letters, and short communication.

RESULTS

Table 1 summarizes the main features of the studies included in this review. The selected studies were conducted in various countries over

different periods and were all published in reputable journals. The technical characteristics considered were population, type of cancer, gender, type of exercise, duration of exercise, intensity, sets, repetitions, timing of the intervention, duration of the study, immunity, and quality of life parameters. The studies involved patients with head and neck cancers, breast cancer, hematologic cancers, small cell lung carcinoma, colorectal carcinoma, prostate carcinoma, liver carcinoma, bile duct cancer, esophageal cancer, central nervous system cancers, skin cancer, urogenital cancers, Hodgkin lymphoma, and non-metastatic cancers. Cancer patients were introduced to various exercise regimens, including combinations of progressive aerobic exercise (AE) and resistance training (RT), RT alone, flexibility exercises, and rehabilitation programs conducted either at home or in hospital settings (Table 1).

The result showed that combined progressive aerobic exercise (AE) and resistance training (RT) in prostate cancer patients undergoing androgen suppression therapy showed significant improvement in QOL, anxiety, depression, decreased tiredness, and CRF (20). Combined progressive AE and RT in prostate cancer patients one week before radiotherapy revealed a significant improvement in anxiety and QOL (21). Combined progressive AE and RT in prostate cancer patients during and after radiotherapy and androgen deprivation therapy improved QOL and fatigue. After anticancer therapy, rehabilitation programs for different types of cancer revealed significant improvements in CRP level, QOL, and Fatigue (Table 1) (22). Combined AE and RT improved QOL in patients with prostate and breast cancer who were undergoing radiotherapy (23). Another study reported that AE, RT, and flexibility exercise in thyroid cancer patients taking thyroid hormone medicine significantly decrease fatigue and anxiety, improving QOL (24). Aerobic endurance training in cancer patients undergoing hematopoietic stem cell transplantation significantly improved QOL (25). Combined AE and RT in non-metastatic cancer patients during chemotherapy, a decline in the CRP was observed in the intervention group, and QOL was improved (26). The exercise duration reported in various studies spans from 15 to 70 minutes per session for 12 weeks. Additionally, QOL questionnaires indicate decreased CRF and improved QOL for regular exercise patients. The technical details of these studies are presented in Table 1.

DISCUSSION

The study aimed to assess the impact of physical activity on QOL in cancer patients and to evaluate CRF and its relationship with physical activity. The review found notable improvements in both QOL and fatigue following exercise. These significant findings may be attributed to the various types of exercise performed by different cancer patients, suggesting that many forms of exercise can enhance the health-related QOL of cancer patients.

The early incorporation of palliative care during the progression of incurable cancers has increasingly gained attention as a practical approach to improve quality of life and mood, as well as to extend survival (12, 27). According to Hojan et al. (2016) (21), Frequent, moderate-intensity exercise enhances functional ability, reduces fatigue, and improves quality of life in high-risk prostate cancer patients undergoing radiation therapy. Similarly, Kim et al. (2018) (24) indicate that a home-based exercise program can significantly benefit patients undergoing thyroid hormone replacement after thyroid surgery by reducing fatigue and anxiety and enhancing their quality of life (QOL). Similarly, earlier studies involving different cancer patients have shown that such exercise programs are both safe and effective in improving QOL and alleviating depression in those who have completed their treatments (28-32).

Ergun et al. (2013) (33) investigated the impact of exercise on angiogenesis and apoptosis markers, as well as on QOL, fatigue, and depression among 63 breast cancer survivors. The patients were divided into supervised exercise, home exercise, and education groups. The study found significant decreases in depression and fatigue in the supervised exercise group. Both exercise groups improved QOL, while the education group did not. These differences may be due to using various QOL scales and variations in exercise type, duration, and intensity (34, 35).

Cancer rehabilitation is a procedure that helps people work within their physical, social, psychological, and vocational limitations (37, 38). Post-rehabilitation has been shown to enhance physical symptoms (such as fatigue and physical endurance), nutritional symptoms (including poor appetite, unintentional weight loss, and nutritional deterioration), psychological symptoms (like anxiety, depression, and nervousness), and overall QOL (21, 39, 40).

Table 1. The characteristics of the included studies

Reference	Sample Size	Cancer Type	Gender	Method (exercise name, duration, intensity, sets, reps)	Timing of intervention	Duration of the study	Immunity and quality of life parameter or Immune component examined	Results	Conclusion
Galvao et al., 2010 (20)	Total= 57 EX= 29 Co =28	Prostate	Male	Patients undergo combined progressive AE & RT. RT included (upper- and lower-body 8 EX, 2-4 sets, 12-6RM) & AE (Progressive cycling and walking 2/w) 15-20 M, 65-80% HR peak	More than 2 MO after starting with androgen deprivation therapy	12 W	general health; QLQ-C30	Significant improvement in QOL: pre-EX: 66.0±23.1, post-EX: 71.4±17.5, P-value= 0.02	Improve well-being and overall QOL of the Prostate cancer patients.
Hojan et al., 2016 (21)	Total= 54 EX=27 CO =27	Prostate	Male	The intervention group undergoes AE for 30 M and 15 M of RT (sets of 8 reps at 70% to 75% of their estimated 1RM). Both EX was about 50 to 55 M at 65-70% VO2M for 5/D/W. The CO group revised only usual care.	EX started one W before radiotherapy	8 W	QOL	Improved QOL: pre-EX: 70.7±2.1, post-EX: 72.3±6.3, P-value= <0.05	Improvement QOL in high-risk Prostate patients after radiation therapy.
Hojan et al., 2017 (36)	Total= 66 EX=35 CO =31	Prostate	Male	The intervention groups undergo AE: 5/S/W for 8W and 3/D/W for the next 10 MO for 30 M. & RT; (2 sets of 8 reps at 70% to 75% for 25 M of their estimated 1RM). Both EX was about 65 to 70 M. with 65% to 70% VO2M. After radiation therapy. The CO received only the usual care	during and after radiotherapy and androgen deprivation therapy	12- M0	FACT-G score and QLQ-C30	Improve all the aspects of QOL: pre-EX: 70.7±2.1, post-EX: 65.91±4.8, P-value= 0.001. CRF: Pre: 42.7±2.1, Post: 39.8±3.7, p-value= 0.001	EX improved QOL and CRF in patients with PC undergoing radiotherapy and androgen deprivation therapy.

Chasen et al., 2013 (22)	Total= 67	Head and neck, Breast, Hematologic=, Non-small cell lung Small cell lung, Colorectal, Prostate, Liverbile duct, Esophageal Central nervous system, Skin, Unknown primary, Urogenital, Hodgkin lymphoma	Male and female	67 patients engaged in the Rehab program for 8 W at the hospital gym 2D/ W under the direction of an Occupational Therapist	after anticancer therapy	8w	Esas, F, and QOL	Significant improvement in QOL: pre-EX: 4.85±2.62, post-EX: 3.89±2.41, P-value= 0.01. F: pre-EX: 4.89±2.6, post-EX: 3.81±2.26, P-value= 0.001	Patients with different advanced types of cancers showed considerable improvements in CRF, functioning, and QOL across several categories.
Sprod et al., 2010 (23)	Total= 38 EX= 19 CO= 19	Prostate and breast	Male and female	AE: (walking) increasing with 5-20% of steps at 3-5 RPE. & RT: 11 EX, increasing towards 4 sets 15 reps: Low to moderate intensity.	the following primary diagnosis, starting radiotherapy of at least 6 W	4W	PSQI scores	Improvement in sleep quality: pre-EX: 7.06±4.26, post-EX: 6.00±3.87, P-value= 0.37	Improvement in QOL and overall sleep quality
Kim et al., 2018 (24)	Total= 43 EX= 22 CO=21	thyroid cancer	Male and female	Patents were asked to perform AE (walking, 3-5 D/W for at least 150 M/W), RT (upper body EX for 2/W for more than 2 sets/ times) & flexibility EX (5 M before and after AE and RT). 30-40 M of EX were considered appropriate.	While taking thyroid hormone medicine	12 W	HADS-A, EORTC QLQ-C30	Anxiety: pre-EX: 13.86±3.31, post-EX: 11.32±2.59, and F: pre-EX: 4.48±1.46, post-EX: 3.52±1.74 were significantly decrease, P-value= 0.001 Improvement in QOL: pre-EX: 70.51±12.33, post-EX: 82.73±10.49, P-value= 0.001	In thyroid cancer patients, a home-based EX program is beneficial in lowering F and anxiety, enhancing QOL, and boosting immunological function. A home-based EX program can be implemented for cancer patients.

Ergun et al., 2013 (33)	Total= 60	breast	female	patients were divided into three groups: 1 – supervised EX group (AE + RT + education program, n=20); performed 45 M/D for 3 D/W under the direction of a professional doctor. 2 – Home EX group (AE + education program, n=20); performed brisk walking for 30 M/D for 3 A/W. Groups 1 and 2 undergo 12 W of EX. 3 – education programme (n=20) followed up for 12 W.	following breast cancer treatments.	12 W	ENA-78, EORTC QLQ-C30, BFI and BDI.	Post-treatment IL-8: pre-EX: 10.37±3.60, post-EX: 7.76±3.10, and ENA-78: pre-EX: l9.64±3.81, post-EX: 7.34±5.29, and TNF-α: pre-EX: 13.01±6.72, post-EX: 11.60±4.71 levels were significantly decreased in the home EX group P-value= 0.03 BDI: pre-EX: 7.75±6.69, post-EX: 4.70±4.10, and BFI: pre-EX: 3.44±2.23, post-EX: 2.86±2.02, and QOL: pre-EX: 80.35±11.22, post-EX: 85.67±8.07, were significantly decreased following the EX, P-value= 0.004	EX-induced changes in angiogenesis and apoptosis-related molecules imply that these parameters may be affected by EX. Patients with breast cancer who have completed their treatments have improved their QOL and reduced their depression.
Baumann et al., 2010 (25)	Total= 64 EX=32 CO=32	malignant with the indication of haematopoietic	Male and female	EX group undergoes aerobic endurance training 2/D on a bicycle ergometer 10-20 M during hospitalization & activities of daily living include walking on the hospital's corridor every D (except weekends). CO group undergoes 20 M/D under the professional therapist at all times.	undergoing hematopoietic stem cell transplantation	, approximately 6 W	EORTC QLQ-C30, hematological parameters (leucocytes, plts, Hb)	All hematological measures show in favor of the EX-group concerning the QOL: pre-EX: 75.8±21.8, post-EX: 61.6±22.7, P-value= 0.006	EX might favorably impact the patient's physiological, psychological, and psychosocial levels during the hematopoietic stem cell transplant. During the EX period, most patients were found to have steady neutrophil engraftment. Patients who underwent hematopoietic stem cell transplantation were not exposed to any additional risks, and on the contrary, the training program appeared to have aided in the patient's recovery process.

Parent-Roberge et al., 2020 (26)	Total= 20 EX=10 CO= 10	non-metastatic cancer		EX group undergoes combined AE and RT. AE was 20 to 40 M (+5 M of warm-up and 5 M cool-down with 50% to 75%) intensity of estimated heart rate reserve (VO2M) & RT intensity was from 1 set of 12–15 reps to 2–3 sets of 10–15 RM. Patients participated 3/S/W, with 2/S under the supervision of the EX-physiologists. While the CO performed 2/S/W of supervised static stretching 30–45/M/S	During chemotherapy	12W	FACIT-F and PASE questionnaire	There was a trend for a significant increase of 4 points on the FACIT-F scale in the intervention group scores following the EX, P-value= 0.10	The study concluded that, in breast cancer patients undergoing chemotherapy, no rise in proinflammatory markers was shown, and EX had a favorable effect on cancer-related F and pain. EX might be a positive factor to improve QOL and decrease F. For cancer patients in the early stages of therapy, combined EX training appears to have a beneficial effect on cancer-related F without altering the fasting systemic proinflammatory profile.

EX= exercise; CO= control; MO= Month; RT= Resistance training; AE= Aerobic exercise; W= Weeks; M= Minute; VO2M= Maximal heart rate; S= Session; H= Hour; D= Day; The Edmonton Symptom assessment system RM= Repetition maximum; RPE= Rating of perceived; FACT¬F= Functional Assessment of Cancer Therapy–Fatigue; FACT-G= Functional Assessment of Cancer Therapy-General; EORTC QLQ-C30= European Organization for the Research and Treatment of Cancer Quality of Life Questionnaire; HADS-A= Hospital Anxiety-Depression Scale-Anxiety; ENA-78= Epithelial neutrophil-activating protein 78; BFI= The brief fatigue inventory; BDI= Beck Depression Inventory; F= fatigue.

According to systematic studies, exercise enhanced QOL in cancer patients with significant evidence, particularly in breast cancer (1, 41, 42). The QOL scores in exercising cancer patients were shown to be higher when compared to controls or baseline values (43, 44). Some studies demonstrate that exercise does not affect QOL in breast cancer patients who have completed the treatment (37, 45-48). In similar observational research, individuals with a lengthy period following diagnosis had better baseline function and QOL scores (31).

The possible molecular mechanisms through which exercise can improve QOL include reducing inflammation, enhancing immune function, and regulating hormonal levels. Exercise has been shown to decrease proinflammatory cytokines and increase anti-inflammatory cytokines, thereby reducing chronic inflammation associated with cancer progression and treatment side effects. Furthermore, exercise can help regulate hormones such as insulin and cortisol, often disrupted in cancer patients, thereby improving overall metabolic health and reducing fatigue (49, 50).

Fatigue is a common early symptom of cancer, often appearing before therapy begins and typically worsening as treatment progresses (51). Fatigue affects almost all patients, with a reported frequency of 99% (52). Several studies indicate that engaging in walking, AE, and resistance training programs can effectively decrease CRF (34, 42, 43). Physical activity may help lower CRF by activating neuromuscular function, causing hemodynamic changes, and decreasing social isolation (53, 54).

Investigating the dynamics of QOL, fatigue, and depression among cancer patients concerning various exercise regimens necessitates a comprehensive survey on a larger scale. Additionally, future research could explore the role of psychosocial support in this context. Furthermore, implementing longitudinal follow-ups would be crucial to discern whether enhanced QOL ameliorates disease severity among patients.

CONCLUSION

The study underscores the profound impact of physical activity on QOL and CRF in cancer patients. Various forms of exercise have been shown to significantly enhance QOL and reduce fatigue, with potential benefits for immune function. This aligns with the growing interest in integrating early palliative care to improve QOL and mood and potentially extend survival in patients with incurable cancers. Comprehensive cancer rehabilitation, including physical, nutritional, and psychological support, further enhances QOL and alleviates cancer-related symptoms. The benefits of physical activity, mainly supervised exercise during treatments like radiation, can vary depending on the cancer stage. Future research should focus on large-scale surveys to explore the mechanisms behind exercise-induced improvements in QOL, fatigue, and depression among cancer patients. Structured physical activity programs could be effective public health interventions to enhance systemic immunity and cancer prognosis at low cost and risk.

APPLICABLE REMARKS

- Effectiveness of Physical Activity: The review highlights that various forms of physical exercise significantly improve the QOL in cancer patients, addressing anxiety, depression, and CRF. These benefits extend across different types of cancer and treatment stages, emphasizing exercise's broad applicability as a supportive care measure.
- Cancer-related fatigue: The study specifically points out that physical activity plays a crucial role in mitigating CRF, a common and debilitating symptom experienced by cancer patients. Regular exercise has been shown to reduce fatigue levels, thereby enhancing patients' overall well-being and functional capacity.
- Types of Exercises: The review discusses a range of exercise interventions, including AE, RT, and flexibility exercises. Whether conducted at home or in hospital settings, these interventions have effectively improved QOL and reduced fatigue among cancer patients.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Rafid Saad Hadi. Acquisition of data: Ali Hasan Alwan Alsabbagh. Analysis and interpretation of data: Ali Hasan Alwan Alsabbagh. Drafting the manuscript: Rafid Saad Hadi. Critical revision of the manuscript for important intellectual content: Rafid Saad Hadi. Statistical analysis: Ali Hasan Alwan Alsabbagh. Administrative, technical, and material support: Ali Hasan Alwan Alsabbagh. Study supervision: Rafid Saad Hadi.

CONFLICT OF INTEREST

The authors reported no potential conflict of interest.

ETHICAL CONSIDERATION

Not applicable.

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FINANCIAL DISCLOSURE

The authors declare no financial interests or relationships that could have influenced the content or outcomes of this study. There are no financial conflicts of interest related to this research.

ARTIFICIAL INTELLIGENCE (AI) USE

AI tools were not used in this manuscript's conceptualization, data analysis, or writing, except for general-purpose language models used for proofreading or editing assistance, when applicable.

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