

The Role of Physical Activity in Cancer Survivorship: A Comprehensive Review

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ABSTRACT

Cancer survivorship is an increasingly important focus in oncology, with physical activity (PA) emerging as a key intervention to enhance health outcomes post-treatment. This review explored the role of PA in improving quality of life (QoL), reducing recurrence risk, and managing treatment-related side effects among cancer survivors. The biological mechanisms of PA, including the reduction of systemic inflammation and improvement of immune function, are discussed. Additionally, the psychological and social benefits, such as reduced anxiety and social support from group-based exercise, are highlighted. Despite these benefits, numerous barriers to PA exist, including physical limitations, psychological challenges, and socioeconomic factors. Facilitators, such as tailored exercise programs and healthcare provider recommendations, can enhance participation. Special considerations, such as cancer type and age, necessitate personalized approaches to PA to maximize benefits for diverse survivor populations. The methodology involved synthesizing data from recent clinical trials, epidemiological studies, and qualitative research. In conclusion, physical activity is a vital component of survivorship care, with the potential to significantly improve both longevity and QoL. Future research should focus on refining exercise prescriptions and developing scalable interventions for widespread implementation in cancer care.

Keywords: Cancer survivorship, Physical activity, Quality of life (QoL), Exercise interventions, Cancer recurrence prevention.

INTRODUCTION

Cancer survivorship represents a critical phase in the continuum of cancer care, encompassing the period following diagnosis and extending throughout the patient's life [1]. With advancements in early detection and treatment modalities, the global population of cancer survivors is growing, now exceeding 18 million in the United States alone [2]. As a result, addressing long-term health concerns and quality of life (QoL) for this population has become an urgent public health priority. Among the myriad of factors influencing survivorship outcomes, physical activity (PA) has emerged as a vital, non-pharmacological intervention with the potential to mitigate treatment-related side effects, reduce recurrence risk, and enhance overall well-being [3]. This review seeks to comprehensively examine the role of physical activity in improving outcomes for cancer survivors. It explores the biological mechanisms underpinning the benefits of PA,

evaluates evidence-based exercise interventions, and considers the psychosocial and behavioral dimensions that contribute to adherence. Furthermore, it highlights the unique challenges faced by diverse cancer types, age groups, and socioeconomic contexts. By integrating findings from recent clinical trials, epidemiological studies, and qualitative research, this narrative review aims to provide a holistic understanding of how physical activity can be leveraged as a powerful tool in promoting survivorship health.

Biological Mechanisms of Physical Activity In Cancer Survivorship

Physical activity exerts a wide range of biological effects that are beneficial for cancer survivors [4]. One key mechanism is the reduction of systemic inflammation, which is linked to cancer progression and recurrence. Regular exercise lowers the levels of pro-inflammatory cytokines, such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF- α),

contributing to an anti-inflammatory environment that reduces the likelihood of cancer recurrence [5]. Additionally, physical activity improves insulin sensitivity and decreases adiposity, both of which are associated with lower risks of cancer development and progression, particularly in hormone-related cancers like breast and endometrial cancer [6]. Exercise also enhances immune function by increasing the activity of natural killer cells and other immune components that help to identify and eliminate residual cancer cells [7]. For cancer survivors undergoing treatment, physical activity helps to mitigate treatment-related side effects such as muscle wasting (sarcopenia), cardiovascular complications, and bone loss. Resistance training has been shown to counteract muscle weakness, while aerobic exercise improves cardiovascular health and reduces fatigue. Collectively, these physiological benefits promote better recovery, reduce the risk of recurrence, and improve overall quality of life in cancer survivors [7].

Psychological and Social Benefits

Physical activity offers profound psychological and social benefits for cancer survivors, enhancing mental health and overall well-being [3]. Regular exercise is associated with reduced symptoms of anxiety, depression, and psychological distress, which are common in survivorship [8]. These improvements are partly due to the release of endorphins, better sleep quality, and increased feelings of accomplishment and control over one's health. Socially, physical activity fosters a sense of community and reduces isolation, as many survivors engage in group-based exercise programs or fitness classes [9]. These settings provide valuable social support networks that enhance motivation and adherence to healthy behaviors. Furthermore, group exercises often lead to the formation of lasting friendships and peer support, which are crucial for emotional recovery post-treatment. The combination of psychological upliftment and social integration not only improves survivors' mental outlook but also promotes long-term engagement in physical activity, which is critical for sustained health benefits.

Barriers and Facilitators to Physical Activity Among Cancer Survivors

Cancer survivors face numerous barriers to engaging in regular physical activity, despite its well-documented benefits. One of the most common barriers is physical limitations resulting from cancer treatment, such as fatigue, pain, or reduced mobility [10]. Survivors often experience lingering side effects, including muscle weakness, joint pain, and cardiovascular deconditioning, which can make even light activity difficult [11]. Psychological factors, such as fear of injury or exacerbation of symptoms, also contribute to

inactivity. Additionally, many survivors face emotional challenges, including anxiety or depression, which further reduces motivation to exercise. Socioeconomic factors play a significant role in limiting physical activity. Lack of access to safe exercise environments, financial constraints, and limited availability of tailored exercise programs are especially prevalent barriers among underserved populations. For older survivors, age-related comorbidities, such as osteoporosis or arthritis, add an additional layer of complexity to physical activity engagement. However, there are facilitators that can enhance participation in physical activity among cancer survivors. Tailored exercise programs, particularly those supervised by healthcare professionals with expertise in cancer rehabilitation, help address individual needs and limitations. Physician recommendations are another strong facilitator, as advice from healthcare providers can motivate survivors to incorporate exercise into their routine. Technology has also emerged as a facilitator, with wearable devices and fitness apps helping survivors track their progress and stay motivated. Group-based exercise programs offer social support, creating a sense of community and accountability that can sustain long-term participation. Flexibility in program design accounting for personal preferences, cultural considerations, and physical limitations further encourages adherence and improves outcomes in this diverse population.

Special Considerations: Cancer Type And Age

The role of physical activity in cancer survivorship varies significantly depending on cancer type and the survivor's age, necessitating tailored approaches to exercise interventions [12, 13]. Different cancers present unique challenges that require specific forms of physical activity to maximize benefits and minimize risks. For breast cancer survivors, for example, concerns such as lymphedema a common complication from lymph node removal or radiation therapy can be mitigated through carefully designed resistance training programs that promote lymphatic drainage without exacerbating symptoms [14]. In contrast, colorectal cancer survivors may benefit more from aerobic exercises that help improve bowel function and reduce gastrointestinal discomfort, along with enhancing cardiovascular health, which is often compromised during treatment. Survivors of prostate cancer, especially those undergoing androgen deprivation therapy, face risks of muscle loss and osteoporosis [15]. Weight-bearing exercises, along with resistance training, can help preserve bone density and muscle mass in these individuals. Similarly, lung cancer survivors may focus on exercises that improve respiratory function and increase endurance, often weakened by both cancer and its treatments. Age is another critical

factor in tailoring physical activity programs. Younger survivors may have more resilience and are likely to pursue higher-intensity exercise regimens aimed at restoring pre-cancer fitness levels. However, they may also face psychosocial challenges like returning to work or school, which can affect their adherence to structured exercise programs. Older cancer survivors, on the other hand, often contend with age-related comorbidities such as arthritis, cardiovascular disease, or reduced mobility [16]. For this population, gentler exercise regimens focusing on balance, flexibility, and functional fitness are crucial to improving quality

Physical activity is a cornerstone of cancer survivorship care, offering extensive physical, psychological, and social benefits that enhance both the quality and longevity of life. While significant strides have been made in understanding how exercise can support survivorship outcomes, challenges remain in ensuring equitable access and adherence across diverse populations. Tailoring interventions to individual needs taking into account the type of cancer, treatment history, and personal barriers will be essential for maximizing

of life and preventing falls. Additionally, older survivors may require more supervised or low-impact activities that prioritize safety while still offering the benefits of physical activity, including improved strength, mental health, and social interaction. In both cases, personalization is key, ensuring that exercise regimens are aligned with the specific health concerns, treatment history, and goals of each cancer survivor. This individualized approach maximizes the therapeutic potential of physical activity while addressing the unique needs of diverse survivor populations.

CONCLUSION

the potential of physical activity as a therapeutic modality in cancer survivorship. As the field of survivorship care continues to evolve, future research must focus on refining exercise prescriptions through randomized controlled trials, exploring the long-term effects of physical activity on cancer recurrence, and developing scalable interventions that can be integrated into routine cancer care. Through these efforts, physical activity can become a universally accessible and life-enhancing intervention for all cancer survivors.

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