DUBIŃSKA, Michalina, PADUCH-JAKUBCZYK, Wiktoria, BILSKA, Wiktoria, CIUŁEK, Urszula, DOBOSZ, Anna and ZDUŃCZYK, Wiktoria. Physical Activity and Its Effects on Cancer Prevention, Survival Rates, and Recovery. Quality in Sport. 2024;22:54321. eISSN 2450-3118.

https://dx.doi.org/10.12775/QS.2024.22.54321 https://apcz.umk.pl/QS/article/view/54321

The journal has been 20 points in the Ministry of Higher Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Higher Education and Science of 05.01.2024. No. 32553.

Has a Journal's Unique 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 r. Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398.

Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).

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The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 15.08.2024. Revised: 12.09.2024. Accepted: 13.09.2024. Published: 16.09.2024.

# Physical Activity and Its Effects on Cancer Prevention, Survival Rates, and Recovery

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## Abstract

**Introduction and Objective:** Physical activity is any movement using skeletal muscles. It can be classified into four main categories: occupational, household, transport and recreational. These activities can also vary in intensity. This article aims to describe how physical activity affects cancer prevention, survival rates and recovery.

**Review and Methods:** Review and summary of studies and meta-analysis of studies available in open-source format on Google Scholar and PubMed.

**State of Knowledge:** Extensive research shows that regular physical activity reduces the risk of several cancers, particularly breast, colon, and endometrial cancers. Epidemiological studies consistently find that more active individuals have a lower incidence of certain cancers. Physical activity is also a useful adjunct to treatment, alleviating its negative effects. The protective effect of physical activity is believed to be dose-dependent, with greater benefits from higher frequencies, durations, and intensities. Recent studies suggest that physical activity may also improve survival rates in cancer patients, particularly for prostate, colorectal, and breast cancers.

**Conclusions**: The current data strongly supports the inclusion of regular physical activity as a key component of cancer prevention strategies. It may also be beneficial for cancer patients to enhance their chances of survival. Public health guidelines stress the importance of exercise to lower cancer risk and improve overall health.

Keywords: Physical Activity, Cancer, Survival, Exercise, Prevention

# Introduction

In 2020, it was assessed that there were approximately 193 million new cancer cases and nearly 10 million cancer-related deaths worldwide [21]. In 2024, the American Cancer Society estimated that there will be 2,001,140 new cases of cancer and 611,720 cancer-related deaths in the USA [1]. The widespread adoption of early screening and advances in medical technology have led to higher cure and survival rates among cancer patients. This shows a trend that more and more of society will live and struggle with this issue.

Many years of epidemiological research have identified a physically active lifestyle as protective against the occurrence of several common cancers. In many studies, participants were given a list of common activities, such as walking, running, or cycling, and were asked to report the frequency and duration of their engagement in these activities. Others were asked more general questions about time spent on moderate - or vigorous - intensity activities. The majority of studies focused on recreational activities, while some also included occupational activities, and a few included housework.

It is estimated that about 35% annual cancer deaths worldwide are linked to preventable lifestyle-related risks [2]. Modifying unfavorable risk factors that elevate the likelihood of developing cancer is crucial. Primary prevention through changes in behavior and environment is a cost-effective strategy to reduce the significant impact of cancer on societies globally [2].

Moreover, physical movement is a key measure for the rehabilitation of many chronic diseases (including cancer), improving quality of life and reducing mortality [22,23]. Additionally, physical activity has a positive impact on anxiety, depression, fatigue, and the decline in quality of life caused by cancer or its treatment [24]. Therefore, it is recommended that multidisciplinary cancer teams should promote exercise among patients.

In this article, we want to summarize information regarding the relationship between physical activity and cancer risk as well as cancer mortality. We also want to present the important role of exercise in the rehabilitation of cancer survivors.

#### **Types of Cancer Linked to Physical Activity**

Over the past years, there's been a significant increase in evidence suggesting that physical activity can play a key role in cancer prevention. In 2008 the American College of Sports Medicine (ACSM) held the first Exercise and Cancer Roundtable which mainly concentrated on the impact of exercise on cancer survivorship [17].

At that point, there was strong evidence linking physical movement to a reduced risk of only breast and colon cancer and limited evidence for a reduced risk of five other cancers [3] (tab.1). Ten years later the Physical Activity Guidelines Advisory Committee (PAGAC) provided strong evidence that sports lower the risk for seven types of cancer, including colon, breast, kidney, endometrial, bladder, and stomach cancers, as well as esophageal adenocarcinoma. There was also moderate evidence suggesting a reduced risk of lung cancer [4].

Parallel to the publication of the PAGAC, an analysis for the second ACSM Roundtable was conducted. This time the scope was broadened to include a review and summary of both biological and epidemiological evidence regarding the role of physical activity in the entire spectrum of cancer prevention and control. Both publications independently reached similar conclusions. Additionally, 2018 ACSM Roundtable determined that there is more limited evidence supporting a protective effect of exercise on hematologic cancers, cancers of the head and neck, pancreas, prostate, and ovary. However, the associations with the last three types of cancer are more uncertain (tab. 2).

Another difference between the reports is the finding that exercise may also reduce the risk of liver cancer.

Based on 10 prospective cohorts and 1,384 cases of this cancer, it was shown that a high level of physical movement was associated with a 27% lower risk of liver cancer compared to low levels of activity [20]. The PAGAC report did not include a meta-analysis for this type of cancer.

Additionally, it was discovered that physical activity might increase the risk of a severe form of skin cancer, melanoma. After evaluating twelve cohorts comprising a total of 12,438 melanoma cases, it was found that a high level of sport activity was associated with a 27% greater risk of developing this cancer compared to low physical movement. Considering the clear evidence that sun exposure is a cause of melanoma, it is highly likely that this association can be attributed to the increased amount of time physically active individuals spend outdoors [19]. However, further research is needed to directly address outdoor physical movement to confirm this hypothesis.

It has also been shown that the relationship between physical activity and lung cancer is difficult to determine. The cause of this is the strong association between smoking and the risk of this cancer. However systematic reviews showed no clear association between exercise and lung cancer risk in never smokers. It is uncertain whether sport activity truly lowers lung cancer risk after adjusting for the confounding effects of smoking. Therefore, further research is necessary to clarify this issue.

Similarly, as in the above case there is some evidence indicating that the link between physical activity and the risk of endometrial cancer might be influenced by body weight.

More studies are needed to clarify the role of body weight in the connection between physical activity and endometrial cancer, as it is crucial for accurately interpreting the conclusions regarding endometrial cancer risk.

All of the above shows that the potential protective effects of physical activity extend to a broader range of cancers than previously believed.

Cancer	Physical activity and lower risk, 2008
Colon	strong
Breast	strong
Kidney	limited
endometrial	limited
lung	limited
prostate	no effect
ovary	limited

Tab.1 The level of evidence linking physical activity with lower risk of cancer in 2008

Cancer	Physical activity and lower risk, 2018
Colon	strong
Breast	strong
Kidney	strong
endometrial	strong
lung	moderate
prostate	limited
ovary	limited
bladder	strong
esophageal	strong
stomach	strong
hematologic	limited
head and neck	limited
pancreas	limited
brain	not assignable

Tab. 2 The level of evidence linking physical activity with lower risk of cancer in 2018

## **Physical Activity in Cancer Patients**

In light of the promising research results on the relationship between physical activity and the risk of developing cancer, the question arises - is there also a connection between physical activity and an increased chance of survival in patients after a diagnosis? Emerging evidence indicates that there is a correlation, particularly for certain types of cancer. Among these, prostate cancer, colorectal cancer and breast cancer have the most robust evidence supporting the beneficial effects of exercise on patient survival [12]. Research suggests that regular exercise can potentially improve treatment efficacy, reduce disease progression, and lead to a better overall prognosis.

Recent studies suggest that physical activity may improve prognosis and survival rate in prostate cancer patients. For instance, research by Kenfield et al. [42] found that vigorous exercise after diagnosis was linked to a remarkable 61% reduction in the risk of death from prostate cancer among men with non-metastatic disease [11]. Additionally, a 2016 meta-analysis encompassing cohort studies indicated that physical activity was associated with a 38% decrease in prostate cancer-specific mortality [10].

Furthermore, both aerobic and resistance training have been shown to alleviate fatigue related to radiation therapy in prostate cancer patients [11]. As a result, exercise is recommended to counteract the negative effects of androgen deprivation therapy and to support both physical and psychological well-being.

There are studies indicating that physical activity may also influence the progression and outcomes of colorectal cancer [12]. For example, an analysis of 13 prospective observational studies revealed that both high and moderate levels of physical activity were associated with notably improved survival rates [13]. Furthermore, according to a different research, a 2016 meta-analysis, which integrated data from seven cohort studies found that the highest levels of activity were associated with a 42% reduction of all-cause mortality among survivors compared to the lowest levels of physical activity [12,14]. Further reinforcing these findings, another 2016 meta-analysis of six cohort studies showed that post - diagnosis physical activity was linked to a 38% reduction in the risk of colorectal cancer-specific mortality [10,12].

These studies highlight the substantial impact of physical activity on overall and cancer-specific survival, particularly important in light of the high prevalence of colorectal cancer, which is one of the most common cancers in both men and women.

Results from various meta-analyses indicate an inverse relationship between amount of physical activity and mortality among breast cancer survivors [12]. One of the studies, a 2015 meta-analysis encompassing data from eight cohorts, researchers found that engaging in physical activity was associated with a 48% reduction in risk for mortality [15]. Different research, 2016 meta-analysis of ten cohorts, found that physical activity lowered the risk of breast cancer-specific mortality by 38% [10]. Additionally, another prospective cohort study demonstrated that participating in at least 2.5 hours of brisk walking per week improved overall survival by up to 32% compared to lower activity levels. Comparing individuals who engaged in physical activity to patients who did not exercise, there was observed a 44% reduction in mortality risk [16].

The link between physical activity and cancer survival remains an area of active research, with early findings indicating a notable 40-50% reduction in mortality risk for breast, colon, and prostate cancers [12]. While these results are promising, they primarily come from epidemiologic studies and lack support from clinical trials focused on improving survival rates in cancer patients. Moreover, many of these studies did not adequately account for other illnesses, different types of cancer treatment, and the diverse ways in which these factors can influence physical activity levels [12]. These variables can greatly influence the results and interpretations of the research. Therefore, it is clear that further research is necessary to explore this topic in greater depth.

## **Biologic Mechanisms**

The progression from normal cells to cancerous tumor is a highly complex, multi-step process influenced by various factors [5]. These factors can be broadly categorized into exogenous elements, such as dietary patterns and lifestyle choices like tobacco smoke, and endogenous factors, which include hormonal levels and genetic mutations.

From a molecular perspective, cancer development is driven by genomic instability (e.g. mutations and epigenetic alterations) that affect critical regulatory genes. These include protooncogenes, which promote cell division, and tumor suppressor genes that prevent uncontrolled cell growth [6].

Preclinical animal studies have provided evidence that physical activity can significantly slow tumor growth in various cancer types [7,8]. Many of those reports reductions in tumor growth ranging from 31% to 67% due to exercise [7,8]. This beneficial effect could be attributed to several mechanisms: physical movement has been shown to hinder cell proliferation, activate tumor suppressor genes such as p53, and improve apoptosis in cancerous tissue [9]. Additionally, exercise has the potential to enhance angiogenesis in tumors. This improvement in vascularization may improve the delivery and efficacy of chemotherapy drugs. Physical activity has demonstrated effects on immune function in humans, with several studies indicating that interleukin-6 may assist in mobilizing natural killer cells and improving immune cell infiltration into tumors [7].

Comprehending the mechanisms of metastasis and its prevention is essential, given that metastatic disease accounts for 90% of cancer-related fatalities [5]. It is theorized that enhanced tumor vasculature, due to exercise, might prevent the release of cancer cells from the primary tumor. Improved cytotoxic immune response, induced by exercise, could diminish cancer cell survival and reduce the development of metastatic lesions [7].

Initial findings from available research suggest that incorporating exercise into cancer care may improve survival rate by enhancing the effectiveness of treatments and inducing systemic changes [6]. While further research is required to fully understand the exact mechanisms by which physical movement affects cancer risk and survival, several plausible biological mechanisms suggest that exercise provides substantial benefits for cancer prevention and management.

## **Intensity and Types of Physical Activity**

While the most extensive evidence pertains to activities like sports and exercise, which demonstrate to lower cancer risk by 10 to 20% when comparing high to low activity levels, some data also exist for other types of physical activities, such as transportation and household tasks [6]. For example, a 2015 meta-analysis found that individuals who engaged in the highest levels of household physical activity had a 16% lower risk of developing cancer compared to those who participated in the lowest levels of household activity [18]. While these findings appear to be encouraging, it is important to note that they are based on a relatively modest number of studies, indicating the need for further investigation.

Research examining the independent effects of low, moderate, and high levels of physical activity on cancer risk is somewhat limited. Nevertheless, the majority of available evidence suggests that moderate to vigorous physical activity is the most effective for cancer prevention across a variety of cancer types [6]. Despite this, a precise minimum amount of daily physical activity required to reduce cancer risk has not been established [6]. Current recommendations advise engaging in 150 to 300 minutes of moderate intensity aerobic activity per week, or an equivalent amount of high intensity aerobic activity - 75 to 150 minutes per week [4].

Cancer development is often a slow process, suggesting that long-term engagement in physical activity may be particularly beneficial for cancer prevention. Studies have measured physical activity over various time frames, including recent months or years, as well as past activities (e.g. in childhood or several years ago). The findings from these studies indicate that recent physical activity is associated with a reduced risk of renal cancer, whereas sustained physical activity over many years is linked to a lower risk of esophageal cancer. Additionally, exercise in various periods throughout a patient's life was connected to a reduced chance of developing bladder and gastric cancers [6].

Different types and intensities of physical activity appear to have varying effects on cancer risk. For instance, vigorous activities, such as running or intense aerobic exercise, are often associated with a greater reduction in risk compared to moderate activities like brisk walking. Furthermore, the type of activity, whether occupational, household, transport, or recreational, can also influence outcomes. Recreational activities are most commonly studied in relation to cancer prevention, likely due to their more measurable nature. However, additional data is required to definitively determine which types and intensities of physical activity are most beneficial for preventing specific types of cancer.

#### The role of physical activity in the recovery of cancer survivors

Physical activity is a crucial component of rehabilitation for cancer survivors. These interventions help manage physical and psychological side effects associated with cancer and its treatments. Exercise enhances quality of life and reduces mortality rates. Sport activity diminishes fatigue, enhances mood, and improves cardiovascular health. Physical movement also helps in weight management, which is particularly important as obesity can be a risk factor for cancer recurrence.

Aerobic and resistance exercises are safe, feasible, and effective for cancer patients during and after adjuvant therapy [25, 26]. According to exercise guidelines for cancer patients, they should gradually resume daily activities post-surgery and aim for at least 150 minutes of aerobic exercise along with 2-3 sessions of resistance training per week [24]. Nevertheless, few patients achieve these targets. A year-long study of women with breast cancer by Arem et al. [27] found that only 33% of patients reached 150 minutes of weekly exercise. This indicates that patients' physical activity levels decline during treatment and remain low in later stages of care.

It is important for exercise programs to be tailored based on the type of cancer, the treatments received, and the current physical condition of the survivor. For instance, high-impact activities should be avoided by individuals with bone metastases due to the risk of fractures. Supervised exercise sessions are recommended initially to ensure proper technique and to adapt the program to the survivor's specific needs. It is also recommended to the intensity of the exercises was increased gradually

Many reviews showed significant positive effects on physical activity outcomes for cancer patients. Studies also indicate that electronic interventions, like activity trackers and pedometers, effectively increase exercise levels, especially moderate-intensity activities [28 - 33]. eHealth tools, including counseling and behavioral change techniques (BCTs), often support these interventions. BCT in combination with activity trackers shows great potential to increase physical movement [34].

Despite the benefits of exercise, cancer survivors often encounter challenges that can make it difficult for them to participate in physical activity. The main barriers include side effects of treatment, lack of time and fatigue [35]. The latter is a common problem among cancer patients, especially those undergoing chemotherapy or radiotherapy [36,37]. Therefore, it is particularly important to increase the level of physical activity of patients through appropriate interventions. A study by Machado et al. [38] showed that physical training is an effective method for reducing cancer-related fatigue, especially in patients undergoing chemotherapy. As research indicates [39-41], by providing patients with guidance on time management, offering effective, time-efficient, and personalized exercise programs, and supporting relevant electronic equipment and online platforms, patients can be encouraged to engage in physical activity. However, more evidence is needed to determine how to improve physical movement levels in cancer patients undergoing treatment, as most reviews focus on participants in the post-treatment phase.

#### Conclusions

Evidence indicates that engaging in physical activity can significantly reduce the risk of developing various types of cancer. Studies have shown that individuals who maintain an active lifestyle have a lower incidence of cancer compared to those who are sedentary. The benefits of physical activity extend beyond prevention; exercise has been shown to potentially improve survival rates, especially among patients with prostate, colorectal, and breast cancer.

Additionally, research has shown that physical movement is instrumental in the rehabilitation of cancer survivors. Regular exercise significantly enhances both their mental and physical well-being, aiding in recovery and improving the quality of life.

The integration of regular physical activity into cancer care plans could offer substantial benefits, providing a non-invasive, cost-effective strategy to complement traditional treatments. However, ongoing research is necessary to refine these guidelines and fully harness their therapeutic potential.

Determining the most effective types and intensities of exercise for cancer prevention and treatment is challenging due to the variations across different cancer types. Nonetheless, numerous studies consistently conclude that moderate to vigorous exercise is generally the most beneficial. This level of activity has been associated with significant health improvements and a reduction in cancer risk.

Understanding how exercise influences genetic, hormonal, and immune pathways could provide deeper insights into its protective effects against cancer. Although there is a preliminary understanding of the molecular mechanisms by which physical activity may affect cancer development, further research is needed to thoroughly elucidate these processes.

## Disclosure

#### Author's contribution

Conceptualization, Michalina Dubińska, and Wiktoria Paduch-Jakubczyk; methodology, Urszula Ciułek and Wiktoria Zduńczyk; software, Urszula Ciułek; check, Michalina Dubińska, Anna Dobosz and Wiktoria Bilska; formal analysis, Michalina Dubińska; investigation, Wiktoria Bilska; resources, Anna Dobosz and Wiktoria Zduńczyk; data curation, Anna Dobosz; writing - rough preparation, Wiktoria Paduch-Jakubczyk, Wiktoria Bilska and Anna Dobosz; writing - review and editing, Michalina Dubińska, Wiktoria Zduńczyk and Urszula Ciułek; visualization, Wiktoria Bilska; supervision, Wiktoria Paduch-Jakubczyk and Urszula Ciułek; project administration, Wiktoria Paduch-Jakubczyk and Wiktoria Zduńczyk; receiving funding, no specific funding.

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

Funding statement

This research received no external funding.

#### **Institutional Review Board Statement**

Not applicable.

**Informed Consent Statement** 

Not applicable.

## **Data Availability Statement**

Not applicable.

## **Conflict of interest Statement**

The authors deny any conflict of interest

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