

The impact of exercise on the prevention and treatment of liver cancer

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Abstract

Liver cancer is a prevalent and fatal form of cancer worldwide, influenced by various risk factors. To explore the role of exercise in preventing and treating liver cancer, as well as the associated molecular pathways, a search was conducted in reputable databases such as Google, PubMed, SID, Scopus, Scholar, and ISC for articles published between 2010 and 2024. Analysis of pertinent research suggests that regular physical activity can serve as a protective factor, decreasing the likelihood of developing liver cancer. Furthermore, evidence indicates that individuals who are more physically active have a lower risk of developing liver cancer compared to those leading a sedentary lifestyle.

Keywords: Liver cancer, physical activity, inflammation, immune system, exercise

1- Introduction

In the modern world, many individuals experience various diseases that can result in death. Specifically, four diseases have been identified as the main causes of mortality: cancer, diabetes, cardiovascular diseases, and chronic respiratory diseases [1]. Cancer is defined by the abnormal growth of tissue in organs, with liver cancer being a specific type that affects the largest organ in the abdomen, the liver. This disease includes two main categories: primary liver cancer, which begins within the liver itself and is commonly known as hepatocellular carcinoma (HCC)¹ or hepatoma, and secondary liver cancer, which involves the spread of cancer cells from other organs that then spread to the liver [2].

Despite the progress in prevention, screening, diagnosis, and treatment, liver cancer continues to see increasing incidence and mortality rates [3]. The prevalence of liver cancer

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in developing countries, particularly in Asian nations, is reported to be 5 to 10 times higher than in other regions [4]. In Iran, the mortality rate due to liver cancer has more than quadrupled from 1990 to 2018 [5]. Lifestyle-related factors such as alcohol consumption, liver cirrhosis, diabetes, obesity, tobacco use, consumption of aflatoxin-contaminated foods, oral contraceptive use, non-alcoholic fatty liver disease, iron overload, hypothyroidism, hyperlipidemia, and family history [4], as well as viral liver diseases such as hepatitis B and C, are significant risk factors for liver cancer [4]. The impact of each of these factors varies across different geographical regions. For example, in the United States, Japan, and Europe, hepatitis B, hepatitis C, and alcohol account for 22%, 60%, and 40% of cases, respectively, whereas in Asian and African countries, the respective contributions of hepatitis B, C, and alcohol are 60%, 20%, and 20%. In Iran, hepatitis B and C are identified as the primary causes of liver cancer [5].

Physical activity and diet are the most significant factors that can be changed to reduce the risk of cancer [13]. For cancer patients, physical training is an effective way to improve their physical health [14]. Exercise interventions during chemotherapy can provide both physiological and psychological benefits, ultimately improving the quality of life for cancer patients [15]. Physical training includes aerobic and resistance training, with most research focusing on the effects of aerobic exercise in randomized controlled trials [16]. However, recent findings suggest that resistance training may have a greater impact on reducing cancer-related fatigue compared to aerobic activity [17]. Studies have shown that both resistance and aerobic exercise can improve symptoms and physical well-being in patients with gastrointestinal cancers during chemotherapy.

The objective of this research is to explore the impact of varying levels of exercise intensity on the prevention and treatment of liver cancer. Given the aggressive and deadly nature of liver cancer, it is crucial to discover effective approaches for its prevention

2- Methodology

We conducted a thorough search for studies on the relationship between physical activity and liver cancer in various reputable databases like PubMed, ScienceDirect, Scopus, as well as Persian databases including the Scientific Information Database (SID) of Jihad University and the National Publications Database (Magiran). Additionally, relevant articles published between 2010 and 2024 were retrieved using Google Scholar. The search utilized keywords such as "sports activity," "exercise," "physical activity," "liver cancer," "exercise and liver cancer," "physical activity and liver cancer," "high-intensity exercise," "liver cancer prevention," and "liver cancer recovery." This search encompassed articles in both Persian and English. To broaden the search, the keywords were combined using Boolean operators "And" and "Or."

The aim of this review study was to investigate the impact of physical activities of different intensities on the prevention and treatment of liver cancer. Research articles published in scientific journals, involving both human and animal studies, were included in the review

up to July 2024. A total of 334 articles were initially identified. After reviewing 40 titles and abstracts, duplicates were removed to ensure that only relevant studies meeting the inclusion criteria were considered. Subsequently, 28 articles directly related to the research topic were analyzed, after excluding articles with similar results, review articles, and those focusing solely on non-exercise interventions such as pharmacological treatments. After excluding articles with similar findings, review articles, and those that only focused on non-exercise interventions such as pharmacological treatments, a total of 28 articles related to the current research topic were examined. Figure 1 demonstrates the process of selecting articles for the systematic review in accordance with the PRISMA guidelines.

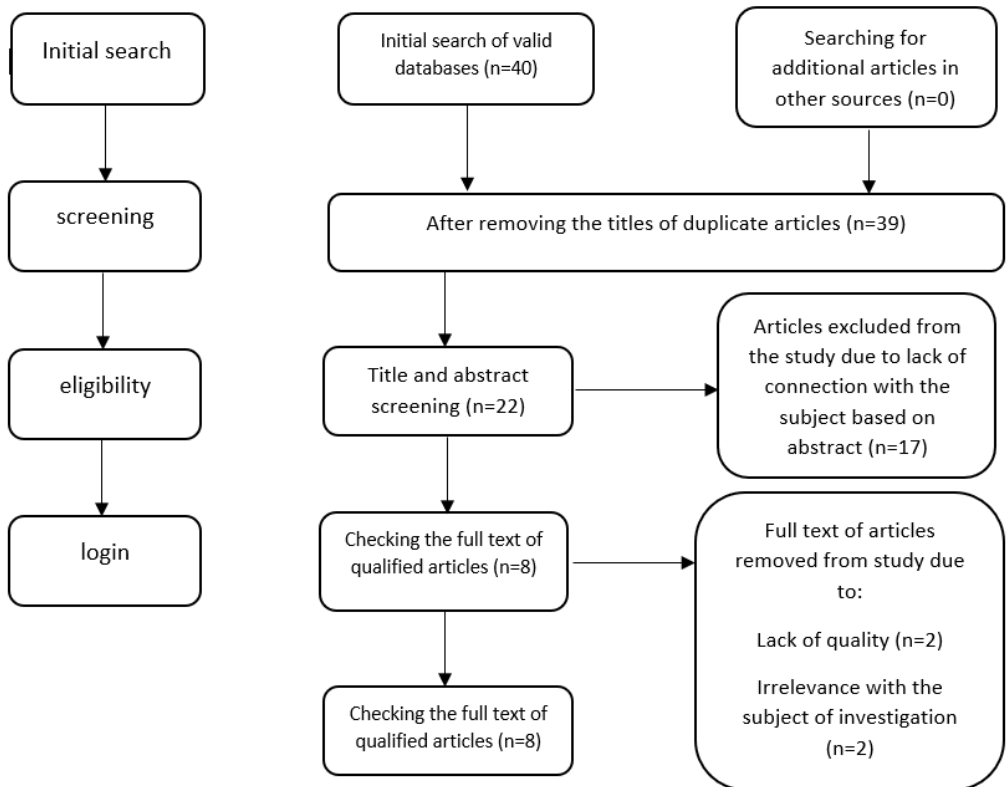


Figure 1. The systematic review process for selecting studies on the relationship between exercise and liver cancer involves several steps.

3. Results

Table 1 presents a summary of human studies that have been published and explore how exercise can prevent liver cancer in individuals who are at a high risk of developing the disease.

Table 1: Summary of Human Research on the Influence of Exercise on the Prevention and Improvement of Liver Cancer.

Subjects	Research protocol	Results
61 patients with liver carcinoma (6).	<i>CPX Test</i>	The results showed that pre- and post-operative intervention with exercise therapy and BCAA supplementation may be beneficial in patients with chronic liver injury.
19 patients with liver carcinoma (7).	During hospitalization, the patients did resistance, stretching and aerobic exercise (20 to 60 minutes per day).	Physiotherapy improves muscle strength without worsening liver function. Physiotherapy may be beneficial in patients with HCC during cancer treatment.
51 patients with hepatocellular carcinoma (8).	Exercising at the anaerobic threshold of each patient started 1 month before the operation, started 1 week after the operation and continued for 6 months.	Postoperative exercise therapy for hepatocellular carcinoma patients with liver dysfunction may improve insulin resistance associated with liver dysfunction and provide benefits for It shows daily exercise regimen after hepatectomy.
20 overweight young men (9).	The exercise program consisted of daily walking for 21 days, on a treadmill with heart rate training for 45 to 60 minutes.	Lifestyle modification in overweight young men without metabolic syndrome can improve the survival of heart cells and reduce the proliferation of hepatocellular carcinoma cells.
During 10 years, 628 cases of liver cancer and 317 cases of bile duct cancer (10).	Questionnaire of physical activity levels according to the frequency of fighting in 20 minutes or more high intensity physical activity per week.	The data of this research support the hypothesis that physical activity reduces the incidence of liver cancer. In comparing the three with the highest and the lowest level of physical activity, we observed a 36% decrease in the risk of developing liver cancer and a 44% decrease in the risk of liver cancer. In contrast, no relationship between physical activity and bile duct cancer was found.

<p>Two observational groups including 77535 women from the nurses' health study and 44540 men from the health professionals' follow - up study were included. The weekly time spent on physical activities was updated every two years (11).</p>	<p>In NHS and HPFS, physical activity via biennial questionnaires since 1986.</p>	<p>Moderate obesity, particularly brisk walking, was associated with a reduced risk of HCC among US men and women. If it is confirmed, the rapid pacemaker may be a suitable way to prevent HCC.</p>
<p>20 patients over and equal 60 years old who failed HCC treatment (12).</p>	<p>online, home and group training sessions per week for 10 consecutive weeks. " Virtual " training sessions are provided in real time by a sports specialist through software and video conferencing. Each session includes 30 minutes of aerobic and resistance training.</p>	<p>In total, the generated data, the designer a prospective randomized controlled trial to evaluate the effectiveness of a remote exercise intervention is reported.</p>

3-1. Review of Research on the Impact of exercise in the Prevention and Improvement of Liver Cancer

Cancer treatment often involves a combination of surgery, chemotherapy, radiation therapy, and hormone therapy. However, in developed countries, there is a growing focus on using physical exercise as a therapeutic approach. The impact of exercise on reducing cancer risk varies depending on the type of cancer. Recent research has particularly looked at how physical activity can help prevent and intervene in liver cancer. Studies have shown that making lifestyle changes can lower the chances of developing cancer (18). Epidemiological studies have provided strong evidence that physical exercise can not only help prevent liver cancer but also reduce the risk of its progression (24). The mechanisms and benefits of exercise on liver cancer processes are complex, including its ability to modulate immune and inflammatory responses. Exercise can also contribute to reducing liver cancer progression by affecting factors such as body mass, sex hormone levels, insulin sensitivity, and immune system activity (25). These effects are influenced by the regulation and modulation of cytokines produced by cells within the tumor tissue, which play a significant role in immune responses (26).

Patient-related factors such as age, gender, and functional status play a role in the development of post-operative complications after stomach surgery for liver cancer. Intraoperative malnutrition and sarcopenia are strongly linked to the occurrence of post-operative complications and poor survival outcomes. Malnutrition is more prevalent in gastrointestinal cancer patients, with a prevalence of 20% to 70%, potentially leading to an increased incidence of sarcopenia (20-23). A study examined the effects of resistance training and walking on individuals over 65 years old with liver cancer and sarcopenia (19),

showing that combining aerobic exercises with resistance training improves protein synthesis. Regular physical activity also triggers anti-inflammatory cytokines and may reduce cancer-related muscle wasting, thus improving the clinical status after liver cancer surgery.

Several other research studies have indicated that resistance training during hospitalization and post-surgery can be advantageous in addressing sarcopenia caused by hepatocellular carcinoma (HCC). Furthermore, evidence from other research suggests that engaging in exercise at the anaerobic threshold and regular walking can be beneficial in reducing the risk of liver cancer by enhancing body composition and cardiovascular fitness.

4. Conclusion

Several research studies indicate that prolonged physical activity can decrease tumor size over time, although the specific underlying mechanisms are still unknown. In a research conducted by Murphy et al., mice with cancer were subjected to a 20-week exercise regimen, and it was noted that the progression of tumor volume was lower in the exercise group, with some instances of negative growth in the later weeks. This decrease in tumor growth was linked to reduced levels of interleukin, leading to the conclusion that there is a direct correlation between tumor volume and inflammatory factors present within the tumor (27). There are varying opinions on the timing and level of exercise required to prevent cancer progression. However, it is generally advised that engaging in 30 to 60 minutes of moderate to vigorous exercise on a daily basis is essential for effectively preventing cancers like liver cancer. Suitable activities include brisk walking, running, or cycling. In addition, everyday tasks such as shopping, commuting without a car, and similar activities can also be considered as forms of exercise. Consistency and regularity in these activities are crucial. exercise should be integrated into daily life. By consistently engaging in exercise, maintaining a healthy weight, and avoiding obesity, not only can the risk of cancer be reduced, but also the risk of cardiovascular diseases, diabetes, hypertension, and bone diseases (28).

According to the findings in this article, it can be inferred that consistent and suitable exercise can have a significant impact in lowering the risk of liver cancer. The beneficial impacts of exercise on the immune system, inflammation reduction, stress management, hormone regulation, and obesity reduction are all factors that can contribute to the prevention of liver cancer. Furthermore, exercise can also play a positive role in the treatment of stomach cancer by reducing post-treatment symptoms and enhancing the quality of life for patients. However, more specific research is necessary to fully comprehend the precise effects of exercise on the prevention and treatment of stomach cancer.

Engaging in exercise following liver cancer surgery holds great significance. Post-surgery, patients may encounter unpleasant side effects like tiredness, muscle weakness, decreased energy levels, and feelings of depression. In such cases, regular and suitable exercise can assist in alleviating these side effects and speeding up the recovery process. exercise after liver cancer surgery can enhance muscle strength, boost energy levels,

decrease fatigue, uplift mood, and even reduce the risk of cancer recurrence. Additionally, exercising after surgery can promote better cardiovascular function, weight management, and digestive function. However, it is crucial to consult with the treating physician before initiating any exercise program after liver cancer surgery, and a personalized exercise plan should be developed for each individual. Close medical supervision during this phase is essential to prevent any side effects or complications. Therefore, engaging in exercise after liver cancer surgery not only aids in improving physical function but also offers emotional support and encouragement. Given its positive impacts, it is advisable to adhere to a regular and suitable exercise routine after liver cancer surgery to enhance overall health.

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