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A Bibliometric Analysis of Global Research Trends of Exercise in Oncology During the Past Three Decades

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Abstract: Recently, studies have found that exercise can promote recovery in cancer patients. Based on bibliometric analysis, this paper discusses the trends and hot spots of exercise oncology research in the past 30 years. The Science Citation Index Expanded of the Web of Science Core Collection (WoSCC) was searched to obtain information on publications and records published between 1993 to 2023.VOSviewer and CiteSpace were used to conduct bibliometric and visual analyanalysis on the overall distribution of keywords and highly cited papers, and a total of 1775 articles were retrieved. Harvard University was the institution with the highest number of publications and Fearon ranked first in 2013 with a total of 605 citations.

Keywords: Exercise oncology; Physical activity; Cancer; Quality of life; Survivors; Prevention; Consensus

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1. Introduction

Recently, the cross-research between exercise and cancer has gradually increased, mainly exploring the beneficial effects of exercise on cancer prevention, treatment, and survival. Exercise oncology studies have shown that regular exercise can improve the quality of life of cancer patients [1–3]. Studies have also shown that exercise plays a positive role in preventing cancer [4–8]. The purpose of this study is to make an in-depth study of exercise research in oncology.

2. Materials and methods

The SCI-expanded Citation Index (SCI-expanded) of the Web of Science Core Collection (WoSCC) database was used for bibliometric analysis. To avoid deviations that were caused by the rapid updating of the database, a literature search was conducted on January 3, 2024. The timeline was set to 1993–2023. The search terms are as follows: [(TS=(Exercise)OR TS=(SPORT)) AND (TS=(oncology) OR TS=(cancer) OR TS=(cancers)OR TS=(Neoplasms) OR TS=(neoplasms) OR TS=(tumors)OR TS=(tumor)) AND (TS= (exercise oncology)]. Only

original English papers were analyzed. A total of 1755 papers were analyzed.

2.1. Data download

Raw data extraction was completed through the SCI extended database. Information included references and keywords. Finally, we imported the data into VOSviewer and CiteSpace software for further analysis.

2.2. Bibliometric analysis

The network was built with VOSviewer1.6.10 software for more comprehensive results. The analysis of co-occurrence keywords presents the research hot spot related to motion in oncology. This article used tools such as cluster analysis, timelines, references, and keyword citation bursts in CiteSpace6.1.R6 software to stay up to date on the field. The keywords and identified key research areas in sports oncology were classified by cluster analysis.

3. Summary of papers on exercise oncology

In this study, 1755 articles were searched. The NC (only noncommercial uses of the work are permitted) of all publications was 31,042, and the average NC of each article was 28.43. All papers had an H-index of 106.

3.1. Analysis of highly cited papers

NC in descending order is shown in **Table 1**. Most of the top 10 most-cited papers were published between 2013 and 2019. The article on cancer cachexia ranked first [9]. This article introduced the mechanism and treatment path of cancer cachexia and believed that affected patients should participate in appropriate exercises in response to "reduced physical activity," such as carrying out necessary resistance exercises. It was followed by the Journal of the National Comprehensive Cancer Network and the Canadian Journal of Cardiology [10,11].

Table 1. Top 10 most cited articles

Rank	Title	Author	Time	Country	NC	Total	IF (2023)
1	Understanding the mechanisms and treatment options in cancer cachexia	Fearon, K	2013	Scotland	55	605	78.8
2	Cancer-Related Fatigue, Version 2.2015	Berger, AM	2015	USA	51.22	461	13.4
3	2017 Comprehensive Update of the Canadian Cardiovascular Society Guidelines for the Management of Heart Failure	Ezekowitz, JA	2017	Canada	58.71	411	7.2
4	Screening, Assessment, and Management of Fatigue in Adult Survivors of Cancer: An American Society of Clinical Oncology Clinical Practice Guideline Adaptation	Bower, JE	2014	USA	38.2	382	45.4
5	Effect of Low-Intensity Physical Activity and Moderate-to High-Intensity Physical Exercise During Adjuvant Chemotherapy on Physical Fitness, Fatigue, and Chemotherapy Completion Rates: Results of the PACES Randomized Clinical Trial	van Waart	2015	USA	42	378	45.4
6	The Impact of Exercise on Cancer Mortality, Recurrence, and Treatment-Related Adverse Effects	Cormie, P	2017	Australia	49.57	347	5.5
7	Exercise is medicine in oncology: Engaging clinicians to help patients move through cancer	Schmitz, KH	2019	USA	68.2	341	254.7
8	Clinical Characteristics, Pathophysiology, and Management of Noncentral Nervous System Cancer-Related Cognitive Impairment in Adults	Wefel, JS	2015	USA	36.33	327	254.7

Table 1 (Continued)

Rank	Title	Author	Time	Country	NC	Total	IF (2023)
9	Effectiveness and Safety of the Awakening and Breathing Coordination, Delirium Monitoring/Management, and Early Exercise/Mobility Bundle	Balas, MC	2014	USA	31	310	8.8
10	Loss of Muscle Mass During Chemotherapy is Predictive for Poor Survival of Patients with Metastatic Colorectal Cancer	Blau-whoff-Busker-molen, S	2016	Nether-lands	29.63	237	45.4

3.2. Analysis of article citations

Figure 1 describes the annual citations of highly cited articles. Fearon *et al*. ranked first with a total citation volume of 605. Their research began in 2013, focusing on the situation of cancer cachexia patients, and innovatively proposed that patients with cachexia should carry out appropriate resistance exercises according to their physical conditions. Schmitz *et al*. also obtained a large number of citations since 2020. The authors put forward a new concept of "exercise is a good medicine" and devoted to popularizing the concept to enable patients to change their behaviors, conduct systematic scientific evaluations of exercise in clinical cancer patients, and establish operational practice standards [12]. In addition, Ezekowitz *et al*. analyzed the guidelines published by the Canadian Cardiovascular Society for the management of patients with heart failure, which showed that exercise had a positive impact on cardiovascular oncology [11]. van Waart *et al*., Cormie, and Balas summarized that different stages of exercise had a better effect on most cancers [13–15].

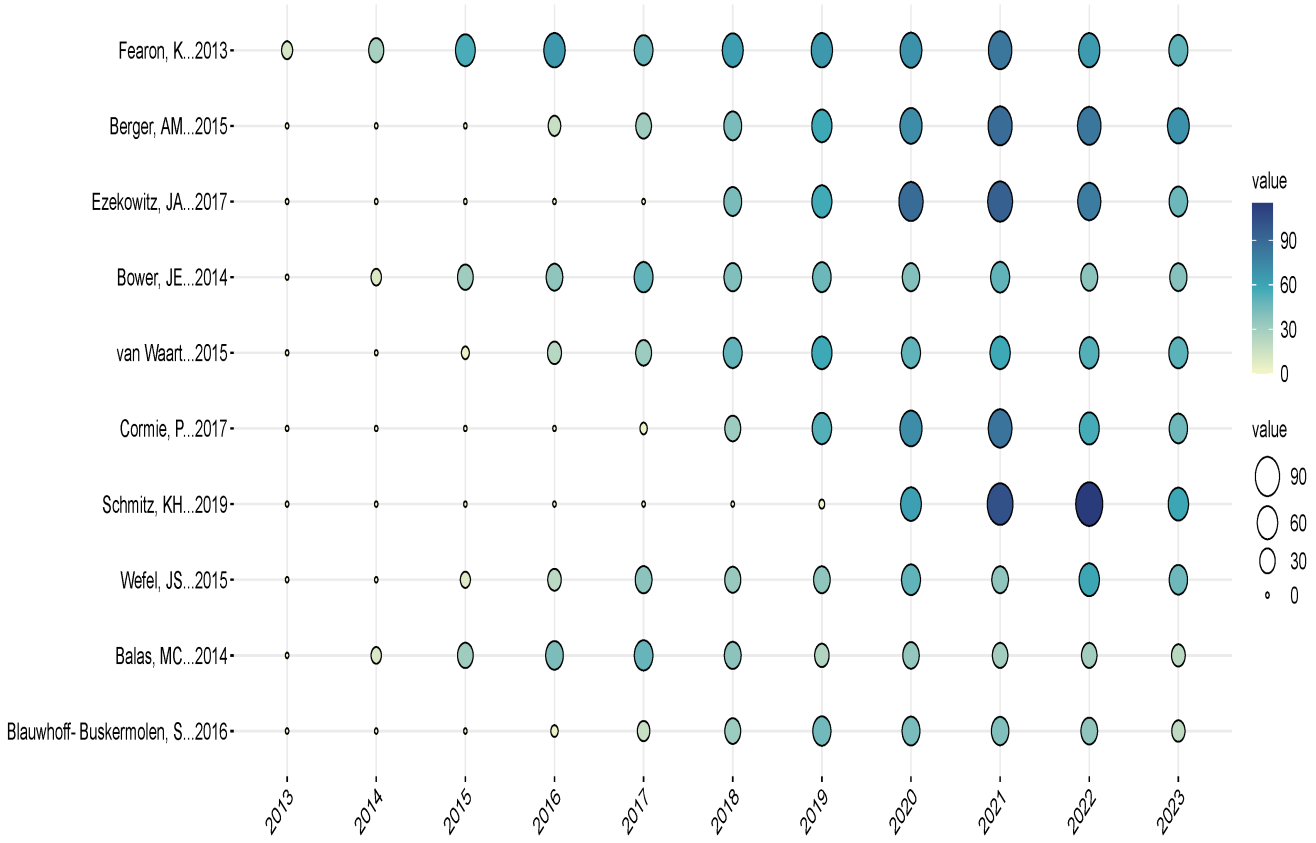

Figure 1. The top 10 articles in the annual Global Citation Score (GCS)

3.3. Analysis of keywords

This paper analyzed the keywords of 1775 papers, as shown in **Figure 2A**. Cluster 1 (32 items, red) focused on exercise, physical activity, and survivors. Cluster 2 (31 items, green) mainly reflected the impact of exercise on quality of life. Cluster 3 (26 items, blue) focused on cancer treatment. Cluster 4 (18 items, yellow) emphasized exercise interventions for cancer. Meanwhile, terms such as "prevention," "consensus," and "sports oncology" were hot topics in the past three years, as shown in **Figure 2B**.

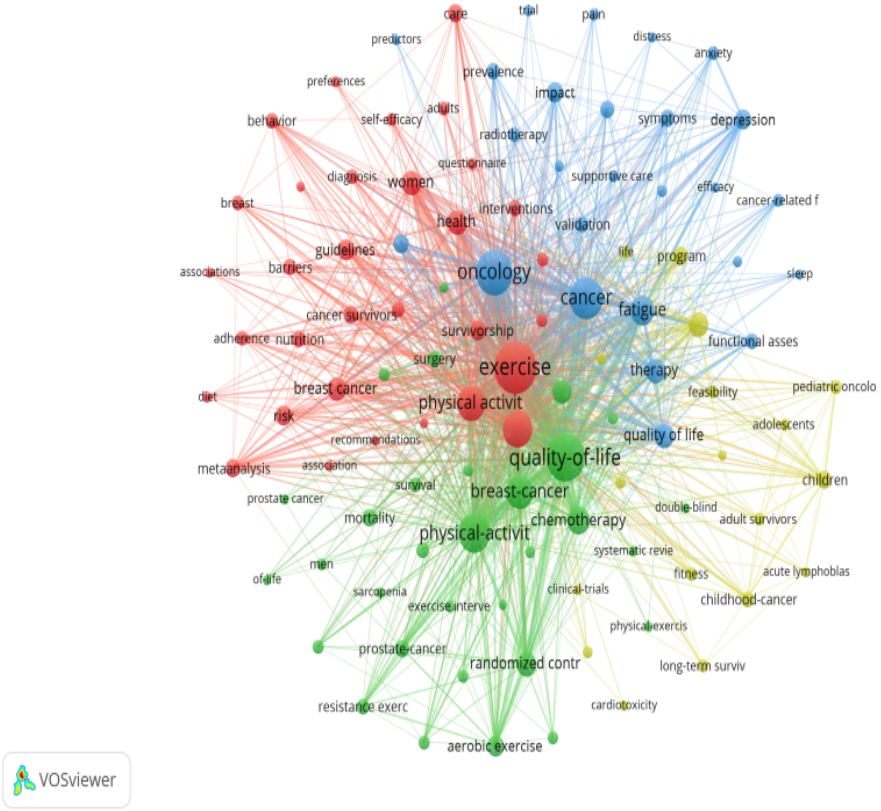

Figure 2A. Keywords co-occurrence network relationship chart

Top 10 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	1993 - 2023
diagnosis	2001	7.66	2005	2015	
randomized controlled trial	2006	8.87	2006	2012	
women	2003	7.23	2006	2012	
self efficacy	2009	6.13	2009	2014	
adult	2004	5.6	2012	2013	
colorectal cancer	1999	4.89	2017	2018	
systematic review	2015	5.48	2018	2019	
exercise oncology	2016	6.13	2020	2023	
consensus	2020	4.9	2020	2023	
prevention	1996	5.14	2021	2023	

Figure 2B. Representative burst citations in the top 10 keywords with the most powerful citation burst.

4. Discussion

This study indicated that the research on exercise in oncology mainly focused on the mechanism and effect of exercise on cancer patients. According to the above analysis, "sports oncology," "rehabilitation," "physical activity," "quality of life," "palliative care," "prevention," and "consensus" could be used as research points. This paper summarized four possible research directions: "The Mechanism of Exercise to Improve Cancer," "How to Exercise to Improve the Quality of Life of Cancer Patients," "Exercise Science Guide in Oncology," and "How Exercise Interferes with Cancer Treatment."

5. Conclusion

This study illustrated the upward trend of exercise oncology research in the past 30 years, which also indicated that this field of research had a good research prospect. The relationship between exercise and cancer and the related clinical research has attracted worldwide attention. The effect of exercise on cancer survival, treatment, and prevention has become a potential research subject of tumor movement research. This study could help scholars to understand the status quo of exercise in oncology research from multiple perspectives.

Disclosure statement

The authors declare no conflict of interest.

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